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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, James T. Case, M.D., Battle Creek, Mich.

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THE PELVIC COLON AND RECTUM—ROENTGENOLOGICALLY CONSIDERED*

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BATTLE CREEK, MICH.

DURING the last decade the efforts of roentgenologists have been extensively devoted to the study of the alimentary tract, and the research in relation to the stomach and duodenum has yielded such highly instructive, profitable and generally reliable results that a roentgen examination of these organs is now willingly conceded to be a necessary part of the diagnostic procedures.

The colon has also received its full share of attention, but further studies and observations will be necessary to reach that agreement among roentgenologists as to the significance of the various findings which alone commands the confidence of the diagnostician and internist.

The anatomy of the colon demands that its various parts be separately considered before their collective roentgenological value can be determined, and for the purposes of the present paper the pelvic segment has been selected for the reason that the methods of examination and interpretation of this part of the intestinal tube have not yet been standardized and there is a degree of uncertainty as to the final diagnosis. This remark does not apply to carcinoma where the roentgenologist can be almost certain of his ground, but it is true of the functional disturbances and the estimation of the significance to anomalies of size, shape and position.

There is a very definite relation between certain symptoms in the proximal portion of the colon and lesions in the terminal 18 or 20 inches of this organ, but the fact has not been sufficiently recognized that symptoms in the region of the cecum and ascending colon may be the direct result of pathological conditions in the pelvic colon. Taking, for instance, constipation, the fact should be recognized that, while this very common complaint is functional in a large percentage of cases and therefore amenable to simple remedies, in other cases it is due to adhesions and other forms of organic obstruction, for the elimination of which the question of invoking surgical aid should be carefully considered.

*Read at the Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, Ill., Sept. 27-30, 1916.

FIG. 1. NORMAL COLON, ENEMA-FILLED.

The pelvic loop has risen up out of the true pelvis, demonstrating its mobility. Compare the caliber of the cecum and ascending colon with that of the iliac and pelvic colon.

The roentgenologist is sometimes asked to examine a constipated patient merely in deference to his or her wish. The attending physician may specify that "there is nothing wrong with the patient but constipation," permitting the roentgenological examination as a concession to the patient's whim. Constipation, however, is not a negligible symptom: on the contrary, it is a complaint which may be far-reaching in its results. Mere relief is therefore not the indicated treatment, but it is the underlying cause of the complaint to which our most careful study should be directed with a view to its removal. It is now a universally recognized axiom that our therapeutic efforts should be directed toward the causes of maladies and, before beginning treatment, we should endeavor to determine definitely the causative factor or factors in each individual case.

Experience has impressed upon me the belief that in the great majority of cases the cause of constipation, when mechanical, is to be found in the pelvic colon or rectum, although the subjective symptoms may seem to be more pronounced in the proximal colon. The constipating lesion is often a complex one and frequently associated with adhesions. Such adhesions are not only a cause of constipation but often also a result of it, the situation thus assuming more or less the nature of a vicious circle.

The rectum itself is susceptible of direct observation, and the need of roentgenological findings in the diagnosis of rectal conditions is not great; yet even here an *x*-ray study is often of great value in determining the extent of the lesion, especially a stenosing lesion of which a proctoscopic study is only capable of revealing the lower end.

The observations upon which this paper is based have been gained on a large series

FIG. 2. NORMAL MASS PERISTALSIS.

A mass (at arrows) in transit under the influence of a spontaneous propulsive movement. This mass, now in the descending colon, has passed within a few seconds from the hepatic flexure to this point, and in 3 or 4 seconds more will reach the pelvic colon.

of patients at the Battle Creek Sanitarium. The roentgen examinations in these cases were made either by my colleague, Dr. L. L. Jones, or myself, while the surgical operations were performed at the Sanitarium Hospital by Drs. Kellogg, Harris and myself.

Before entering upon the details of our findings, it may be opportune to define the meaning of the anatomical terms used in order to avoid confusion. The term "sigmoid colon" is used rather loosely to denote the terminal portion of the colon, ending at the rectum. According to the nomenclature used in modern Anatomies, the sigmoid is the term applied to the iliac and pelvic colons. The iliac colon extends from the crest of the ilium to the inner border of the left psoas muscle, and the pelvic colon extends from the termination of the iliac colon at the inner margin of the left psoas muscle to the front of the body of the third sacral vertebra, forming, when empty, a somewhat acute angle with the rectal ampulla. The length of the pelvic colon is variable, the average being 17 inches. The position of the pelvic colon is also variable, and its most common arrangement, as given by Cunningham and verified by numerous roentgenological studies, is as follows:

Beginning at the margin of the left psoas, it plunges over the brim into the pelvis, crossing this cavity from left to right. It next bends backward and returns along the posterior wall of the pelvis toward the middle line where, turning down, it merges with the rectum.

The empty normal colon lies in the posterior part of the pelvis immediately in front of the rectum, rising, as it becomes

FIG. 3. APPEARANCE OF COLON AFTER SPONTANEOUS MASS PERISTALTIC MOVEMENT.

Roentgenogram of the colon 26 hours p. c., showing the characteristic appearance after a spontaneous mass peristaltic movement, by which the contents of the ascending colon and the right half of the transverse colon have been moved into the distal colon.

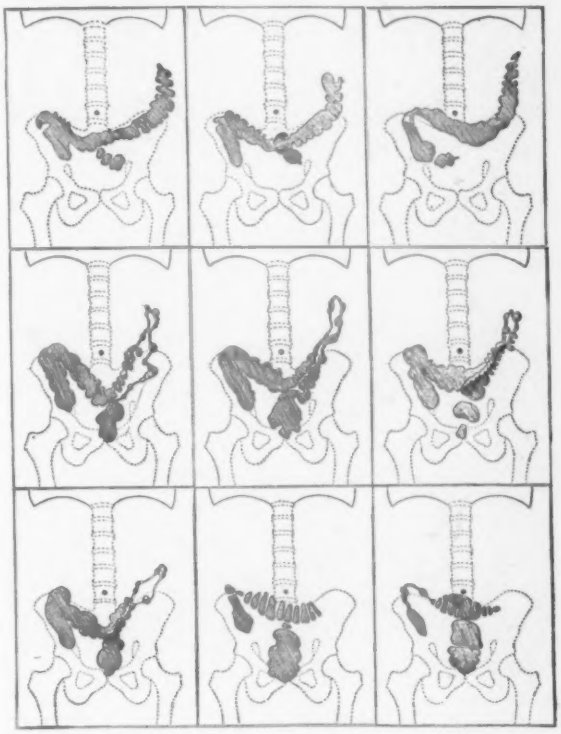

FIG. 4. TRACINGS OF PERISTALTIC MOVEMENTS.

Tracings from a series of roentgenograms by Rieder made at half-hourly intervals, all conditions being the same except for the influence of peristalsis. Note the changes in the position and shape of the transverse colon, which Rieder describes as "large pendulum movements."

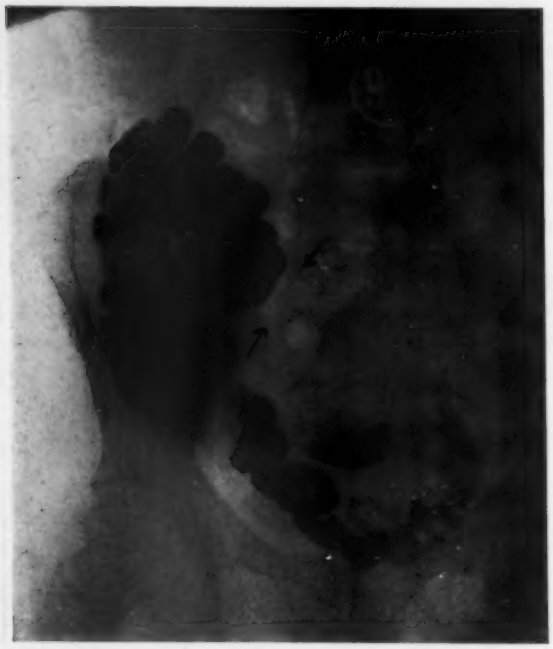

FIG. 5. COLONIC ANTIPERISTALSIS.

Banking up of material in the cecum, ascending colon, and right third of the transverse colon in the antiperistaltic zone proximal to the tonic constriction ring, marked by arrows.

filled, into the abdominal cavity, so that the angle it forms with the rectum becomes less acute.

It is very important to note that the pelvic colon normally forms a freely movable loop, its mesentery being longest in the middle of the loop and shortest at the extremities. We therefore expect to find the large bowel relatively fixed at the junction of the iliac with the pelvic colon (iliopelvic junction) and at the junction of the pelvic colon with the rectum (pelvirectal junction).

The transportation of food into the distal colon is principally brought about by the so-called "mass movements," first described by Holzknecht. By these mass movements, which are said to occur about six times daily, large boluses or masses of fecal matter are rapidly carried across the transverse colon into the distal portion of the bowel.

Other movements by which the transportation of food occurs are the large pendulum movements, first described by Rieder, and the small pendulum movements, which are also called haustral contractions. The latter have been particularly well described by Schwartz.

Normally, the descending and the iliac colon are found either empty or containing a small quantity of fecal matter in transit. The fecal matter gradually accumulates in the pelvic colon above the pelvirectal flexure which, as above stated, is formed by the junction of the pelvic colon with the rectal ampulla. Here a normal obstruction occurs to the onward passage of the feces, as O'Beirne was the first to show.

Until just before the act of evacuation the rectum is normally empty, except occasionally for a few traces of fecal matter, remainders of the previous defecatory act. As fecal matter continues to descend from above, the pelvic colon gradually fills from

FIG. 6. COLONIC ANTIPERISTALSIS.

Another roentgenogram, one of many which could be shown, demonstrating again the appearance of material banked up in the antiperistaltic zone (the proximal colic zone of Keith).

below upward. As it fills it rises, so that the acute angle it forms with the rectum, when empty, is obliterated, thus rendering the propulsion of fecal matter into the rectum easy. The passing of this matter from the pelvic colon into the rectum results in a sensation of fulness which leads to a desire to evacuate the bowels. Hertz draws attention to the fact that such desire, if absent, may be voluntarily produced by contracting the abdominal muscles and diaphragm, which would force fecal matter into the rectum, thereby setting up certain impulses which pass to the defecatory centre in the lumbar spinal cord where they set the reflex acts in motion necessary to complete the evacuation. Among these activities strong peristaltic contractions of the colon will occur which result in mass movements.

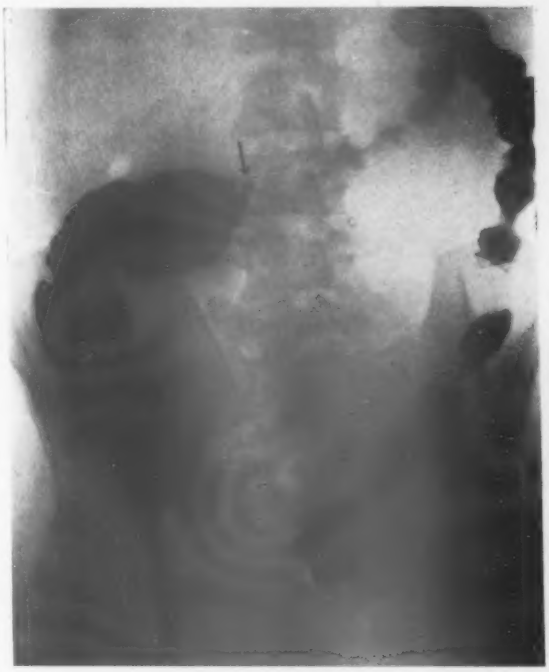

FIG. 8. ROENTGENOGRAM MADE 9½ HOURS P. C., SHOWING DELAY IN THE ANTIPERISTALTIC ZONE PROXIMAL TO THE TONIC CONSTRICTION RING. (See arrow.)

FIG. 7. ROENTGENOGRAM OF CASE SHOWN IN FIG. 6, MADE 50 HOURS P. C.

Note the spasticity of the descending, iliac and pelvic portions of the colon, and a persistent tendency to accumulation of food residues in the proximal colon. The author considers this a characteristic appearance in cases of exaggerated antiperistalsis, due either to an organic or a functional obstruction in the distal colon.

It was formerly believed that the strong peristaltic contractions of the large bowel, completing the act of defecation, were limited to the portion of the colon below the splenic flexure, but I have assured myself from numerous observations that these powerful contraction movements frequently begin in the ascending colon and even in the cecum. They are to the best of my belief identical with the peristaltic mass movements above referred to, by which food is propelled from the proximal colon into the distal colon. The most favorable time for observing mass movements is immediately after defecation. It is also noteworthy that many patients in whom we have observed these mass movements have exclaimed at the time of the movements that they felt as if they could move the bowels.

In the act of defecation the large intestine is normally emptied below the splenic flexure, the proximal colon and the right half of the transverse colon being the seat of antiperistalsis, as has been shown by

FIG. 9. CARCINOMA OF THE DESCENDING COLON. (See arrows.)

An enema has been given, filling the rectum and pelvic colon. The barium in the right upper quadrant is the remnant of a previous opaque meal and occupies the upper small bowel, cecum and ascending colon. See Fig. 10.

Cannon, Jacobi, and others, in animals, and by my own experiments[1] and those of others in man. As a result of these antiperistaltic influences a certain delay occurs in the proximal colon, permitting further digestive and absorptive processes to take place.

As above stated, the normal defecatory act should clear the colon below the splenic flexure; when the colon is tested by the injection of the opaque enema, the patient should be able to expel the entire enema contents of the colon at one effort, but when the pelvic colon is bound down by adhesions or fixed by the pressure of large pelvic tumors, the pelvic loop fails to empty. In some cases there is absolute inability to expel fecal matter owing to anal fissures, hemorrhoids, rectal ulcers or atony of the rectal musculature. Such cases should be classified under rectal constipation. In another class of cases the rectum can only be emptied below the pelvirectal junction, owing to a kind of invagination of the too redundant pelvic colon.

Again, in a large percentage of cases the patient can empty the rectal ampulla and more or less of the pelvic loop, but no more. On re-examination, it is characteristic that the point of apparent hindrance is always the same and may be described as occurring at the pelvirectal junction, the middle of the pelvic loop or just below the iliopelvic junction, as the case may be. Such hindrance is, in my opinion, definitely associated with fixation of the colon, usually by adhesions, and their presence may be established by careful fluoroscopic observation of the colon before and

FIG. 10. ROENTGENOGRAM OF CASE SHOWN IN FIG. 9, FIFTY HOURS AFTER THE OPAQUE MEAL.

The enema has been expelled from that portion of the colon below the tumor. See arrows. The right half of the bowel is densely filled, showing plainly the evidences of exaggerated antiperistalsis.

[1] "X-Ray Observations on Colonic Peristalsis and Antiperistalsis," Seventeenth International Congress of Medicine, London, 1913.

after normal defecation and in connection with the barium enema test, both during its injection and after its expulsion. It may be more appropriate to speak of this condition as abnormal fixation.

When tested by the opaque enema, the ampulla suffers marked dilatation in cases of adherent pelvic colon, the amount of distention depending upon the degree of obstruction, the length of time it has existed and upon the question whether the patient has made an earnest effort to keep the bowel cleansed by enemas. Some of the most pronounced cases of rectal distention have been observed in patients who have practiced the injection of large enemas.

When at the time of the injection of the opaque enema the rectal ampulla is seen to be widely distended, it may be assumed

FIG. 11. ENEMA-FILLED COLON, ILLUSTRATING A RARE OBSERVATION ON ANTIPERISTALSIS IN THE COLON.

As the enema was being administered, a ring of constriction seemed to form near the pelvirectal junction and travel oralward in the direction indicated by the arrow. Several minutes were required for the wave to progress as far as shown in the roentgenogram.

FIG. 12. A CASE OF PELVIC COLON ADHESIONS WHERE THE ADHESIONS, BY THEIR NATURE, SERIOUSLY INTERFERE WITH THE EVACUATION OF THE COLONIC CONTENTS.

This case was completely relieved by operation to break up the adhesions.

that this is due to one of two causes: either the case is one of marked rectal stasis with associated dilatation of the rectal ampulla, or it is a case of pelvic colon obstruction. In the latter case the distention is brought about by the pressure necessary to force the enema past the obstruction. The differential diagnosis between these two conditions can easily be settled by study following the ingestion of the barium meal. In rectal constipation the head of the barium column reaches the rectum promptly, sometimes within seven or eight hours, and yet at the end of fifty or seventy-four hours the rectum is still packed full of fecal residue, whereas in constipation due to adhesions of the pelvic colon the stasis is more apt to occur in the proximal colon through the influence

FIG. 13.

FIG. 14.

FIG. 15.

FIG. 16.

FIGS. 13 — 16. FOUR CASES OF RECTAL CONSTIPATION.

The roentgenograms shown in Figs. 13 and 14 were made 26 hours after the meal. Case 13 was due to inflamed hemorrhoids and Case 14 to rectal atony. The roentgenograms in Figs. 15 and 16 were made 50 and 74 hours, respectively, after the meals, and illustrate extreme grades of rectal constipation.

of antiperistalsis or at any rate in the distal colon above the obstruction. Sometimes both lesions are present in one patient.

Enterospasm very often attends adhesions of the pelvic colon, but it may also be present as an expression of irritation of any other kind. Possibly the nodal bundle presiding over this segment of the colon is the seat of disease or irritation; or there may be a chronic colitis or a diverticulosis, or any of a number of conditions simulating colitis or associated with this condition as a symptom. The work of Keith brings forward a very attractive, though not yet convincing, theory concerning the cause of enterospasm.

Patients, and even physicians, sometimes express doubt as to the importance of the lesion in the distal colon, when the symptoms are mostly right-sided. Distention of the cecum, ascending colon, and stagnation of the intestinal contents in this portion of the bowel, is a most logical result of obstruction in the pelvic colon, no matter whether the obstruction is organic or spastic. The symptoms and findings of the proximal colon are doubtless the result of exaggerated antiperistalsis. This explains why appendectomies for so-called chronic appendicitis are frequently followed by persistence or prompt return of the pains, so much so that patients may doubt the removal of the appendix. The explanation is that the appendix was not the offending organ primarily, but shared in the stasis of the proximal colon as a part thereof. The pains were not appendical but cecal, and due perhaps to distention rather than inflammation.

As has been shown by Eastman and numerous others, prolonged retention of fecal matter in the bowel may give rise to subacute pericolic inflammatory processes which may also share in the production of pain.

A persisting spastic contraction of the pelvic colon offers an obstruction which may be as serious in its resulting alimentary toxemia as an organic lesion. Associated with spasticity in the pelvic colon, there is often a dilatation of the proximal colon leading ultimately to an atonic condition of the bowel musculature in the cecum and ascending colon, the patient's complaint being chiefly in reference to the cecum and ascending colon.

Some cases of pelvic colon spasticity are found to be associated with multiple diverticula, the detection of which I have fully considered elsewhere.[2] Carcinoma of the pelvic colon or rectum is occasionally the associated lesion.[3] Both carcinoma and diverticulosis are important causes of pelvic colon obstruction, aside from the enterospasm they may set up. No more space will here be devoted to these subjects, as the principal object of this paper is to urge the importance of adhesions of the pelvic colon, of dealing with them surgically in properly selected cases, of adopting an operative technic which will tend to minimize the formation of such

FIG. 17. ADHESIONS OF PELVIC LOOP ON LEFT SIDE NEAR PELVIRECTAL JUNCTION.

[2] *Am. Jour. Roentgenol.*, Feb., 1915, Vol. II, No. 2, p. 64.
[3] *Interstate Med. Jour.*, July, 1915, Vol. XXII, No. 7.

FIG. 18. CASE OF MARKED CONSTIPATION, ASSOCIATED WITH ADHESIONS OF THE PELVIC LOOP, PREVENTING THE LOOP FROM RISING DURING THE INJECTION OF THE OPAQUE ENEMA. (See Fig. 19.)

adhesions, and of emphasizing the inadvisability to operate for these adhesions when carefully conducted roentgen studies fail to furnish proof of obstruction. Most adhesions do not obstruct. The pelvic colon is more or less fixed at its two ends, and freely movable in the middle of the loop; hence, the adhesions will be most significant when they can be shown to involve the middle of the pelvic loop.

The method of dealing with these adhesions surgically is a vexing one, and a problem to which we feel the last answer has not yet been given. In our work we have occasionally done the Kellogg operation,[4] by which the pelvic loop, when fixed, is supported in its lifted position by attachment to the omentum, the latter being sutured to the anterior abdominal wall. This secures for the pelvic colon a swinging attachment which holds it out of the bottom of the pelvis without fixing it. The results of this type of operation, though not done on a large number of patients, have usually been very satisfactory in the cases selected for surgical relief.

The mere determination of the presence of adhesions is not a sufficient indication for operation: there should also be proof of the functional disturbance due to, or associated with, these adhesions. This fact can not be too strongly emphasized.

It also seems proper to raise the question as to whether it is advisable to use the pelvic colon for covering up raw surfaces in the pelvis after certain operations, such as hysterectomy. No objection is raised to covering raw surfaces by the pelvic colon, provided this organ is allowed to fall into its natural position in so doing; but usually the pelvic colon is crowded down in this procedure in a manner that invites the very kind of disturbing adhesions to the discussion of which this paper is devoted.

FIG. 19. ROENTGENOGRAM OF THE SAME CASE AS FIG. 18, AFTER THE PATIENT'S RECOVERY FROM OPERATION FOR PELVIC COLON ADHESIONS AND OMENTAL SUSPENSION OF THE FREED PELVIC LOOP (Kellogg's Operation).

Constipation much improved.

[4] "A New Procedure for Suspension of the Pelvic Colon."—*Am. Jour. Surg.*, Ap., 1917, Vol. XXXI, No. 4.

Turning more particularly to the examination of the rectum, it has already been stated that roentgen aid is not often called for. When such, however, is the case, the best means of studying it is by enema, administered in the usual manner, with the patient lying prone. The container is held about two feet above the patient, and the tube is connected with the rectum by the ordinary rectal point, no effort being made to insert it further than just within the sphincter. As seen anteroposteriorly, the rectal shadow is more or less vertical, limited below by the sphincter ani and above by the pelvirectal junction, which usually is situated in front of the body of the third sacral segment. Laterally, incisures are seen corresponding to Houston's valves. The lowest valve is situated on the left side about 6 cm above the anal orifice, the middle on the right side at a distance of about 9 cm, and the superior on the left side at a distance of 11 or 12 cm. The distance from the anal sphincter to the pelvirectal junction is usually about 15 cm. The average diameter of the rectal shadow (enema-filled) is about 5 or 6 cm, but it varies considerably under the following conditions:

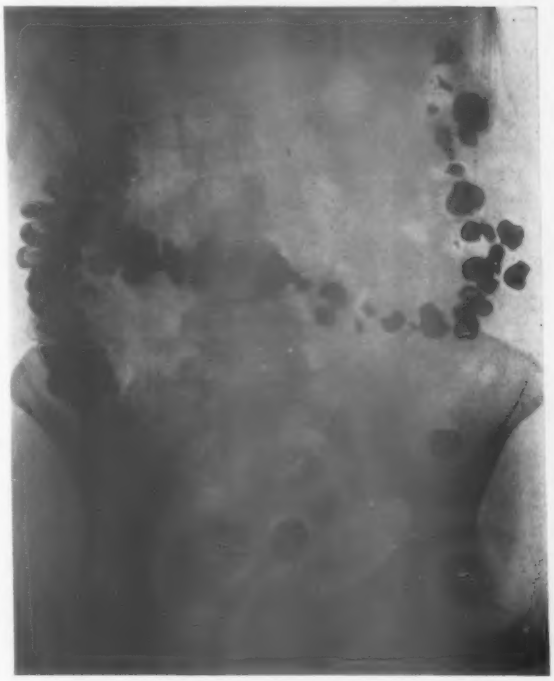

FIG. 21. ANOTHER CASE SHOWING A SIMILAR APPEARANCE TO THE PREVIOUS ROENTGENOGRAM AFTER INDIGESTION OF OPAQUE MEAL.

Note that the isolation of the boluses is more marked the nearer they approach the distal end of the colon.

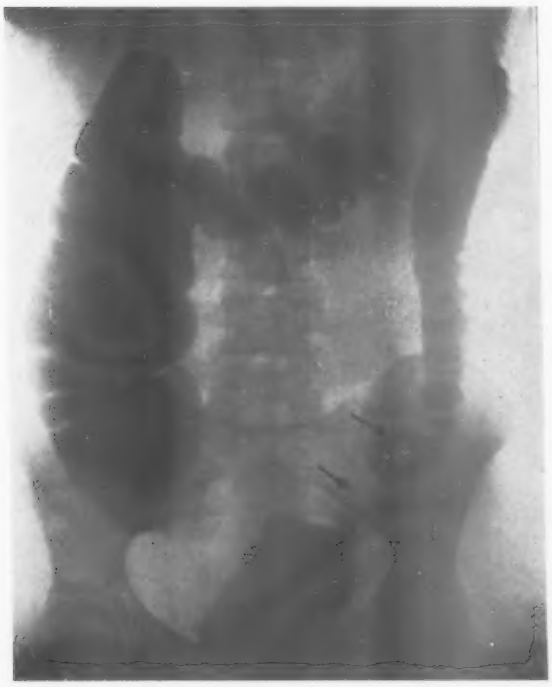

FIG. 20. TYPICAL CASE OF SPASTICITY OF DISTAL COLON, ENEMA-FILLED.

Spasticity most marked at arrows.

(1) As the result of *distention* owing to increased pressure required to pass the enema above the stricture in the pelvic colon. This stricture may be malignant, it may be due to extracolonic pressure of some tumor, to adhesions of the colon, to tumor of the left tube or ovary, or to the parietal wall, or it may be due to spasm. Spastic contractions of the pelvic colon do not have the same appearance of spasticity as do contractions in the stomach. In the latter organ spastic indrawings are usually narrow, well defined and clear-cut; in the colon, spastic contractions involve whole segments of the bowel, ranging from a few to many inches.

(2) *Rectal Constipation.*—A proctoscop-

ic examination must be made to determine whether the constipation is due to spasm of the anal sphincter, attending anal fissure, acute inflamed hemorrhoids, or severe proctitis, or whether the condition is merely one of atony of the rectal musculature.

(3) *Carcinoma.*—In carcinoma the rectal walls are more or less indurated, depending upon the amount of involvement.

FIG. 22. CASE OF GENERALIZED SPASTICITY OF THE ENTIRE COLON, THE ISOLATION OF THE BOLUSES BEING UNIFORM THROUGHOUT.

This is a case of an organic nerve lesion (metastatic malignancy in the cord). Contrast with Fig. 21, which shows a class of spasticity very commonly encountered in constipated individuals and often associated with colitis.

The filling defect may vary from a small spot in one side of the rectal shadow to a large annular defect, including almost the entire rectum. The characteristic feature of the carcinomatous lesion is that it is irregular, contrasting sharply with the smooth, elongated canal to which the rectum is reduced in syphilis. My experience does not extend to tuberculous rectal lesions. A localized malignant lesion

FIG. 23. CASE OF ULCERATIVE COLITIS, INVOLVING PARTICULARLY THE RECTAL AMPULLA.

Note the flecking on the walls of the air-distended bowel.

FIG. 24. NORMAL RECTUM FILLED WITH MATERIAL OF UNUSUAL OPACITY.

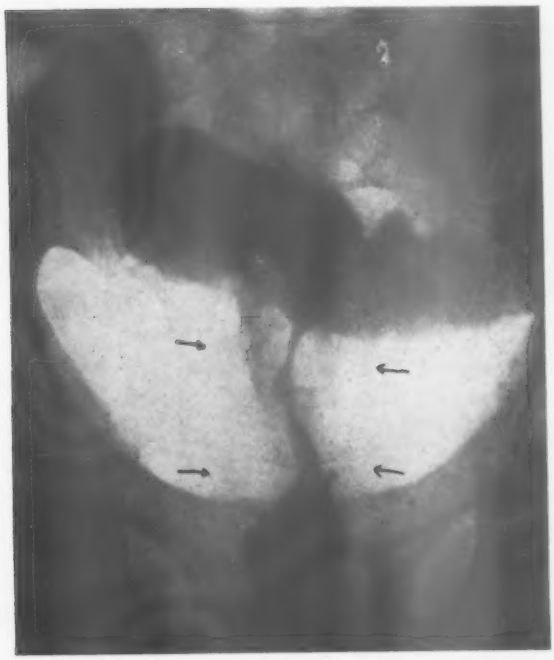

FIG. 25. A CASE OF EXTENSIVE CARCINOMA IN THE RECTAL AMPULLA. (Inoperable.)

FIG. 26. A FAIRLY EARLY CASE OF CARCINOMA OF THE RECTUM. (Operated.)

FIG. 27. CARCINOMA OF THE RECTUM.

The roentgen method could have discovered this long before it became inoperable.

FIG. 28. CARCINOMA OF THE PROSTATE WITH RECTAL INVOLVEMENT.

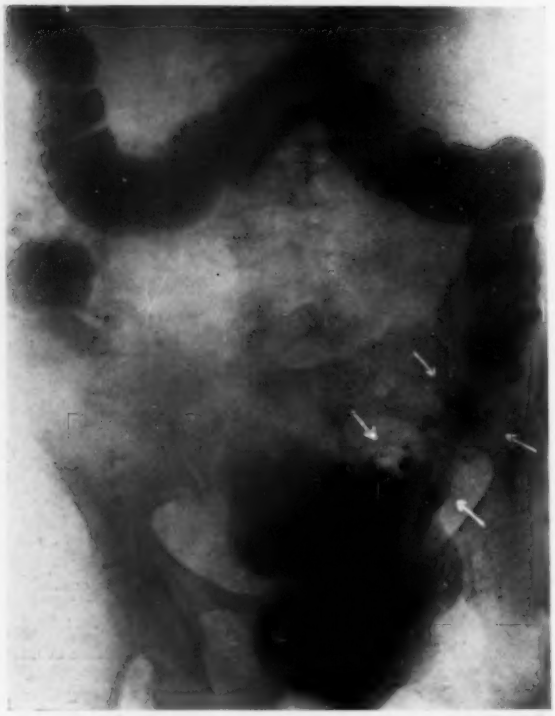

FIG. 29. FILLING DEFECT IN THE RECTAL SHADOW DUE TO EXTENSION OF CARCINOMA FROM THE UTERUS.

may be difficult to differentiate from large indurated rectal ulcers and should in any case be regarded with great suspicion.

It is not only possible to recognize carcinoma originating in the rectum but also carcinomatous extension from uterine or prostatic malignancies. I have on several occasions during roentgen examinations discovered malignancies in the rectum which had up to that time been undiagnosed and unsuspected.

(4) *Syphilis.*—Rectal syphilis is a lesion rarely encountered, at least in roentgenological practice. But the appearance of this lesion at the time of the rectal injection is so characteristic that, once seen, it can never be forgotten. The rectal channel is converted into a narrow canal, more or less elongated, according to the extent of the lesion. The first portion of the injected material shoots up this narrow canal with astonishing rapidity. In the cases we have recognized, the filling defect is smooth-edged and more extensive than in any malignant lesion I have yet seen in a living patient. Probably a good many syphilitic lesions of the rectum are being mistaken for malignant disease, and it is not uncommon for the error to be discovered after the surgical excision has been made.

(5) *Fistula in Ano.*—When the lesion is a simple, short, non-indurated, fistulous tract, injection of the rectum with an opaque enema will not show any characteristic deformities of the rectal shadow. In such cases the introduction of Beck's paste into the fistula will be of much more value, but where the tract is extensive there is likely to be induration sufficient to produce a characteristic defect in the rectal shadow.

Even though the rectum is easily examined by the direct method, a roentgen examination is advisable in all cases of

FIG. 30. FILLING DEFECT IN THE COLON SHADOW DUE TO EXTENSION OF CARCINOMA FROM THE PROSTATE.

FIG. 31. A CASE OF MULTIPLE DIVERTICULA OF THE COLON WITH TUMOR (AT ARROWS) IN THE LEFT ILIAC FOSSA.

Many of the diverticula can be seen by their denser rounded shadows. This condition is one of the most important to be differentiated from carcinoma. The diverticula contain barium which was eaten 72 hours previously. The colon was otherwise emptied, and is now injected by enema to show the relation of the diverticula to the colon.

FIG. 32. A CASE OF SYPHILIS OF THE RECTUM.

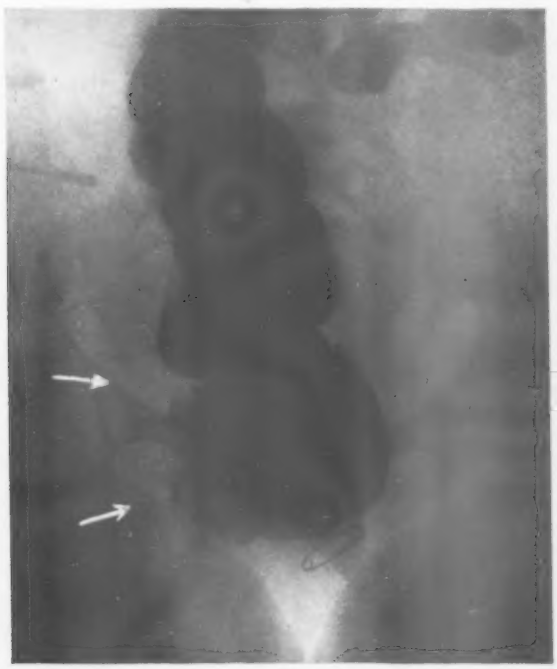

FIG. 33. CASE OF HIGH GRADE ANAL SPASM, DUE TO ANAL FISSURE.

FIG. 34. FILLING DEFECT IN THE RECTAL SHADOW (AT ARROWS) DUE TO EXTENSIVE INFILTRATION OF TISSUES IN A CASE OF FISTULA IN ANO.

rectal lesions. Additional information, confirmation or refutation may be gained, especially when it is necessary to differentiate between luetic and carcinomatous lesions. The irregular filling defect of carcinoma, involving a relatively small segment of the bowel, is clearly distinguishable from the smooth-edged, elongated, narrow rectal shadow of syphilitic involvement. The roentgen examination is also of value in determining the extent and characteristics of the upper border of a stenosing rectal lesion which will not permit the passage of the proctoscope.

FIG. 35. PHOTOGRAPH OF THE CASE ILLUSTRATED IN FIG. 36.

We have occasionally found the iliac or pelvic colon as part of the contents of an inguinal or scrotal hernia. Provided the hernia is not replaced, the position of the colon in the hernia is easily recognized following either a barium meal or enema. One of the most striking cases I have encountered was an inguinal hernia containing pelvic colon in an old man with an enormous scrotal hernia (Fig. 35). To my surprise the roentgen examination revealed multiple diverticula of the colon, the diverticula being most numerous in the portion of the colon located in the scrotal hernia (Fig. 36). The only published case at all similar to this was an even more striking scrotal gastrocele, communicated by Albers-Schoenberg.

It is also frequently found that the pelvic colon is adherent to the appendix vermiformis or to the uterine appendages.

In the foregoing I have endeavored to emphasize the value of the roentgen meth-

FIG. 36. ROENTGENOGRAM OF AN UNUSUAL CASE OF MULTIPLE DIVERTICULA OF THE PELVIC COLON CONTAINED IN A LARGE SCROTAL HERNIA. (See Fig. 35.)

od and elaborate on our findings in relation to a number of rectal and pelvic colon lesions, and particularly to bring out certain facts relating to adhesions of the pelvic colon. The diagnosis of malignancy of the pelvic colon is already on a sound basis, but the recognition of functional disturbances of the bowel due to the adhesions, spasticity, and abnormal arrangements of the pelvic colon is a matter beset with considerable difficulties and one that requires the exercise of our best and broadest judgment.

DISCUSSION ON PAPERS OF DRS. CASE AND GEORGE*

DR. EDWARD H. SKINNER, Kansas City, Mo.—Dr. George did not give his percentages. In many of these gastro-intestinal cases, if a patient has stomach symptoms severe enough to have prompted the internist to refer the case for a roentgen examination, there is trouble somewhere. If the roentgen examination determines a normal stomach and duodenum, a non-visualized appendix and no pain in the appendix region by palpation under the fluoroscope, there is a 90% chance that gallbladder disease is present. In such a case the surgeon will usually agree with you in a diagnosis of gallbladder disease. I have not made a diagnosis upon many gallbladder plates because I have been too timid. I always hesitate about being too sure of gallbladder or gallstone shadows.

I liked Dr. Case's presentation because his roentgen information was well visualized.

DR. GEORGE C. JOHNSTON, Pittsburgh, Pa.—I want to thank Dr. George for changing his terminology. Patients demand to be shown their gallstones on the plates. If you cannot show them, they refuse to submit to operation. Therefore, many people are harboring unopened diseased gallbladders, because we could not show stones. We ought not to use the term gallstones at all. We should forget it. Gallbladder disease is a different proposition entirely. What Dr. Skinner said about percentages of diagnosis in gallbladder disease is true. Fifty per cent. of women have gallbladder disease whether they complain of it or not. If roentgen examination were made of all women who complain of gallbladders, 95% would be found to have gallbladder disease.

Dr. Case interested me exceedingly as usual. He has taken us entirely through the gastro-intestinal tract now, and thus has finished his work on the bowel. He failed to call attention to the patulous ileocecal valve, probably because he was working on the pelvic colon and rectum.

DR. L. G. COLE, New York City.—My experience with gallstones is exactly in accord with that of Dr. George.

DR. GEORGE E. PFAHLER, Philadelphia, Pa.—I am just as enthusiastic over gallstone diagnosis as Dr. George is, and I am sure that I have made many successful diagnoses of gallbladder disease and of gallstones. I have made mistakes too. We are all bound to make them in a new field. We find something that leads us to believe that it is the gallbladder and gallstones, when later it proves to be something else. Until we learn just what these things are, we are bound to make mistakes.

DR. JAMES T. CASE, Battle Creek, Mich.—Unless we can appreciate the fact that ileocecal valve incompetency, about which I have talked considerably in the past, is an end-result, we have not really grasped the situation. Time is the best test and I am waiting. Ileocecal valve incompetency is, in a certain class of cases, analogous to the lesions in the heart due to dilatation with relative insufficiency. When we have a relative dilatation of the proximal colon, it is only natural that the valve lips will be pulled apart and incompetency will result. In most of the cases I showed, there was such an incompetency. The obstructive lesion in the distal colon, no matter to what it may be due, whether functional or merely spastic, produces the same symptoms in the proximal colon as antiperistalsis in its exaggerated sense. Many times it is stasis in the cecum, which means it is in the appendix, because it has no valves. Some conditions bring about stasis in the terminal ileum. Spasticity in the pelvic colon involves not only a small segment of bowel, but many inches, sometimes even a foot or two, and that is why

* The paper of Dr. George appeared in the July number.

ileocecal valve incompetency is present in most of the cases shown.

DR. A. W. GEORGE, Boston.—What Dr. Skinner and Dr. Johnston said about percentages is true, but many patients are sent to us for lung examinations who have no bacilli in the sputum. You might say: Why make a roentgen examination in such cases? This work is not difficult, although it seems to be difficult. Many of the slides which I showed to-day were somewhat indefinite but a lesion of the gallbladder was distinctly visible. When you get interested in this work and do a lot of it, you will be surprised how often the gallbladder can be outlined. It does not make much difference what symptoms are present. All you have to do is to interpret the shadows and then permit the internist to make the diagnosis and outline the treatment. I think the time is coming when the question of the gallbladder will be settled definitely, as was that of the appendix. I think early cancer can be diagnosed by the roentgen ray; in fact it is the only method of examination which will show the early changes of cancer. But on the other hand, I am not going to disregard our early work on cancer because of the possibilities that have arisen by reason of the findings of the pathologist.

ROENTGENOLOGICAL INTERPRETATION OF ACCESSORY SINUS VARIATIONS*

BY H. J. PRENTISS, M.D.

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IOWA CITY, IA.

HAVING made a careful analysis of all skulls passing through the Anatomical Laboratory of the State University of Iowa for the past four years, I have found such an astonishing variation in the accessory sinuses, that I decided to spend some weeks with my friend Dr. Eugene Caldwell of New York in an attempt to interpret the roentgenograms of these sinuses, with the dissections for reference. The stereoscopic pictures indicated the condition clearly, but that is not a part of the present paper.

The sinuses, as found in the frontal bone, should be regarded as extensions from the ethmoid labyrinth. Keeping this in mind, their appreciation is relatively simple. There are also extensions from this labyrinth into the superior maxilla and even into the nasal septum, although the reason for their presence is open to conjecture. Bearing in mind connective tissue development and the reaction of connective tissue cells to stress and strain, we may speculate as to why these interesting sinuses develop. In the case of the maxillary sinus, on closure of the mandible, we see how the lines of force are directed along the walls of this bone and not centrally. With the lateral growth of the calvarium, to keep up with the lateral growth of the brain, we see why a large central cavity develops in the maxilla, and its walls are firm to resist the thrust of the mandible.

The same is true of the bones of the foot. The thrust is downward and backward, and downward and forward in the direction of the arches of the foot. Between or in the vertical thrust of the tibia, the os calcis shows such a rarefaction of the bony lamellæ that apparently just enough remains to hold the bone together. In cases of flat foot, where the thrust is vertically downward, I have observed massiveness of these bony lamellæ and a marked rarefaction of the lamellæ in the direction of the tuberosities of the os calcis. Does not this imply a right to conclude that osteoblasts and osteoclasts react to mechanical stimuli,

* Read at the Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, Sept. 27–30, 1916.

to build up or break down as the stimuli vary? Possibly unusual stimuli may account for sinus variation.

I fail to see how this subject can be handled from the embryological side, since the frontal and orbital sinuses are absent at birth and only an indication of a maxillary sinus is present. The lateral mass of the ethmoid has become spongy, but with no extensions into other bones. The naso-frontal duct, however, is fully formed. Usually the naso-frontal duct extends upward between the two tables of the vertical portion of the frontal bone, forming the frontal sinus. This extension may vary from a small cell to a cavity extending laterally to the parietal articulation. These sinuses may present smooth walls or many septa dividing them into a series of loculi, and be either confined to the region of the superciliary ridge or extend to the frontal eminences. From this condition of a true frontal sinus the excavation may extend backward into the orbital plate, even approaching or encroaching on the sphenoidal wings (Fig. 1, right).

In one case (Fig. 2, *a*, *b*, *c*) it extends into the great wing of the sphenoid so that a roentgenogram would indicate a large sphenoidal sinus rather than an orbital sinus extension.

The next variation (Fig. 1, left) is where the naso-frontal duct divides at the level of the lower table of the orbital plate, one opening leading into a frontal and the other into an orbital sinus. These two sinuses connect by a small foramen which the operator might detect by a probe.

The next variation (Fig. 4, right) occurs where the naso-frontal duct divides into a Y-division, the anterior leading into a frontal and the posterior into an orbital sinus. In this case there is no evident connection, as far as the operator is concerned. The sinus occupying the orbital plate, or orbital sinus, may occupy either a small part or all of the orbital plate, even encroaching upon the wings of the sphenoid.

The next variation (see Fig. 3) is observed where a middle ethmoidal cell extends into the orbital plate, having no connection with the naso-frontal duct.

The next variation (Fig. 3) is where the naso-frontal duct expands into a frontal sinus (*a*), an anterior ethmoidal cell expands into an anterior orbital sinus (*b*), while a posterior ethmoidal cell expands into a posterior orbital sinus (*c*). Here there is no connection except through the general labyrinth.

The next variation (Fig. 5, *a* and *b*) is again where the naso-frontal duct divides into a Y-shaped division. The posterior branch expands into an orbital and the anterior into a frontal sinus. The latter extends medially into the crista galli and downwards into the vertical plate of the ethmoid almost to its lower limit. I have a number of frontal sinuses extending into the crista galli.

The next variation is where the frontal sinus of one side extends to the opposite side in front of the other. Frequently the posteriorly placed sinus is but a small cell. This type is fairly frequent. A modification of this type (Fig. 6, *a*, *b*, *c*) is where the frontal sinus of one side extends to the opposite side in front of the other sinus, while the latter extends to the opposite side behind the former sinus. In this case the opening of the naso-frontal duct into the anteriorly placed sinus is but a slit because of the encroachment of the posteriorly placed sinus. Again the anteriorly placed sinus is connected across the median plane by a slit owing to the encroachment of the posteriorly placed sinus.

The next variation (Fig. 7, *a*, *b*, *c*) consists in expansion of the ethmoidal cells into orbital sinuses, some lower placed ethmoidal cells extending laterally into the ethmoid plate and forming a two-storied orbital sinus variation. The specimen in this laboratory shows the extension of the inferiorly placed sinuses about one-third of the distance across the orbital plate. The superiorly placed sinuses extend completely across. Another variation consists in posterior ethmoid cells extending posteriorly at the expense of the sphenoid sinus. A remarkable variation of this type (Fig. 8, *a*, *b*) shows a huge posterior eth-

moid cell extending dorsally above the sphenoidal sinus of the same side and terminating above the sphenoidal sinus of the opposite side.

In another variation (Fig. 9, *a*, *b*) the frontal sinus dips down into the anterior part of the middle turbinated bone. This laboratory has a number of specimens, where posterior ethmoid cells extend forward into the middle turbinate, developing it into a large cell. Fig. 10 shows a variation where a cell in the lateral wall of the naso-frontal duct extends laterally into the body of the superior maxilla. This cell passes behind the lacrimal canal and reaches to the infra-orbital canal, running directly behind the infra-orbital arch. This laboratory has three such specimens.

Another variation, Fig. 11, *a*, *b*, has a posterior ethmoid cell extending laterally at the expense of the superior maxillary sinus, reaching to the infra-orbital groove.

A certain detail in variation is of more interest to the operator than to the roentgenologist. I find three types of variation of cellular extension ventrally to the naso-frontal ducts and between the frontal process of the superior maxilla and the anterior thin lamella of the lateral mass of the ethmoid: (1) a cellular extension upward and forward from the infundibulum between the frontal process and this thin lamella, developing a cell in this region which is quite distinct from the naso-frontal duct; (2) a forward extension from the naso-frontal duct between these two bones, developing a cell directly connecting with the naso-frontal duct; (3) a downward and forward extension from the frontal sinus between the two bones, again developing a cell quite distinct from the naso-frontal duct (Fig. 13, *a*, *b*, *c*).

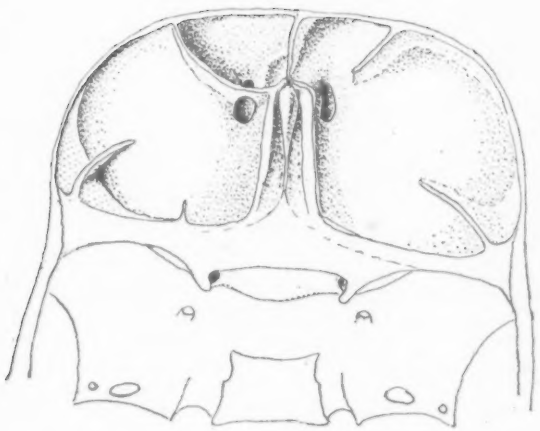
I will but briefly discuss variations in the superior maxillary sinus.

The usual lower limit of this sinus is at the level of the palate process projection. The extreme limit (Fig. 12, *a*, *b*, *c*) as found in this laboratory, is where the sinus extends from the orbital plate to the lowest limit of the alveolar process. In this case the roots of the molars straddle this sinus, projecting up on the basal and lateral walls of the body of this bone. Even the tip of the root of the cuspid tooth reaches to the floor of this sinus. The minimum limit is where the sinus reaches from the orbital plate to the level of the antral opening.

This laboratory presents two cases (from the same skull) of loculi in the sinus which are not extensions from the ethmoidal labyrinth. Each sinus presents a large cell, which extends from the infra-orbital arch backward to a transverse line, about bisecting the antral opening. Laterally this cell extends to the infra-orbital canal, medially to the basal surface of the maxilla.

The conditions which tend to variations are as follows: In the first place, the facial surface of the body may be so concave that it fuses with the basal surface. It is readily seen why the sinus cannot extend forward in such a case. In the second place, the basal surface may be so concave that it fuses with the facial surface, similarly delimiting the forward extension of the sinus. In the third place, both conditions of concavity may occur on the same bone. A marked convexity of the facial surface can greatly extend the sinus anteriorly. This laboratory possesses a remarkable skull. It shows a marked scoliosis to rectify a distinct curvature of the spine. The right half of the skull is markedly built up, with a corresponding diminution in the growth of the opposite half. The facial surface of the right maxilla bulges forward, causing a large maxillary sinus. I might say that there is an absence of a left middle ear. The foramen ovale and foramen spinosum of this side are practically obliterated. The lateral sinus of this side instead of passing to the jugular foramen, leaves the skull via the mastoid foramen. I hope to report this skull in great detail at some future time. I have used one drawing in a number of cases to demonstrate more than one variation. I also have only reported upon cases found in this laboratory. In regard to sphenoidal variations, I reported upon this matter in the *Iowa State Medical Journal*, issue of July, 1915.

ILLUSTRATIONS



Right

FIG. 1. Upper table of both orbital plates of frontal bone removed. Right side shows one large sinus. Left side shows a small foramen connecting the frontal and orbital sinuses.

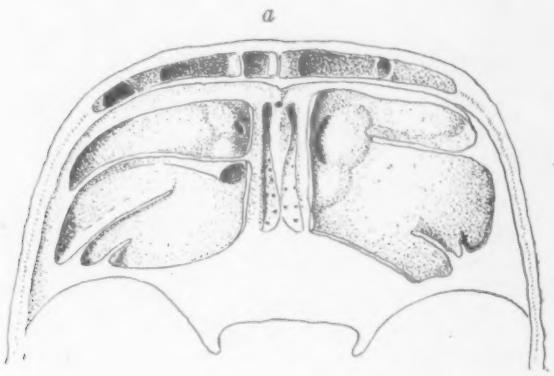


FIG. 2. *a*, Upper table removed. Showing outline of a lower tier of orbital sinuses; *b*, lateral extension of frontal sinus; *c*, to show orbital sinus extension into great wing of sphenoid.

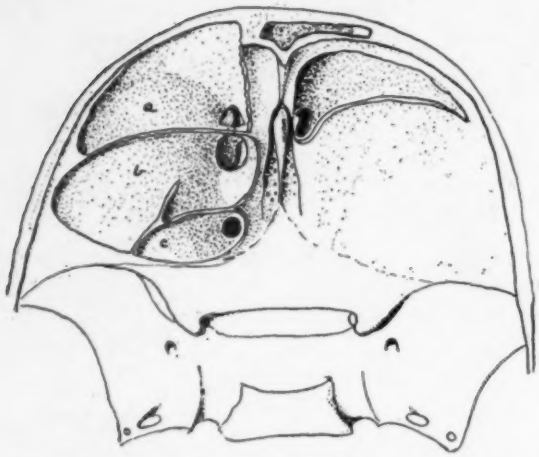


FIG. 3. *a*, Frontal sinus; *b*, anterior orbital sinus; *c*, posterior orbital sinus.

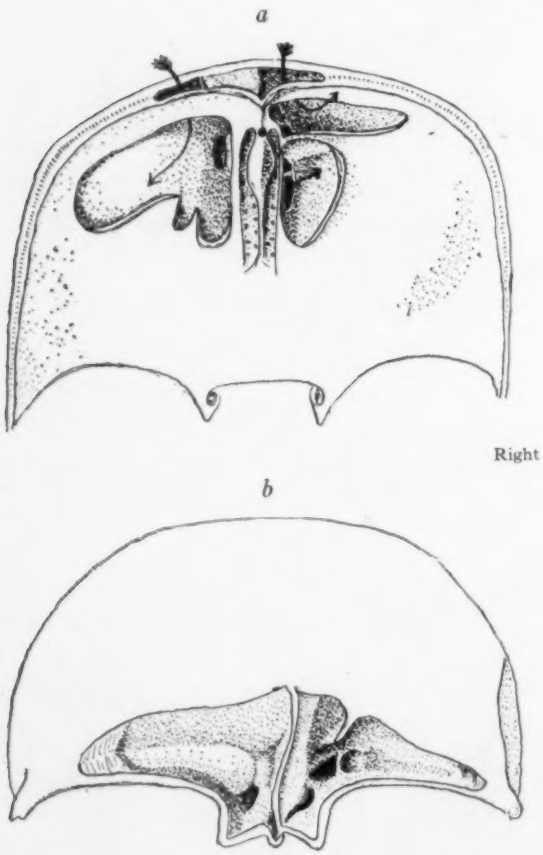


FIG. 4. *a*, Right side shows complete separation of frontal and orbital sinuses. Left side shows frontal sinus continuous with orbital extension; *b*, shows on right the septum separating the frontal sinus from the orbital.

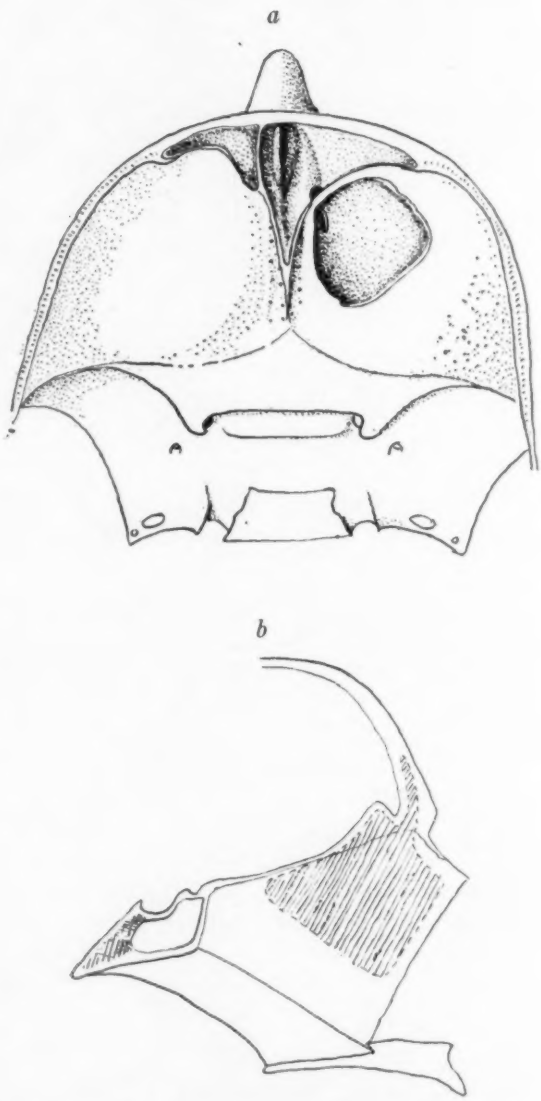


FIG. 5. *a*, To show the right frontal sinus extending into the vertical plate; *b*, also an orbital sinus connecting by a Y with vaso-frontal duct.

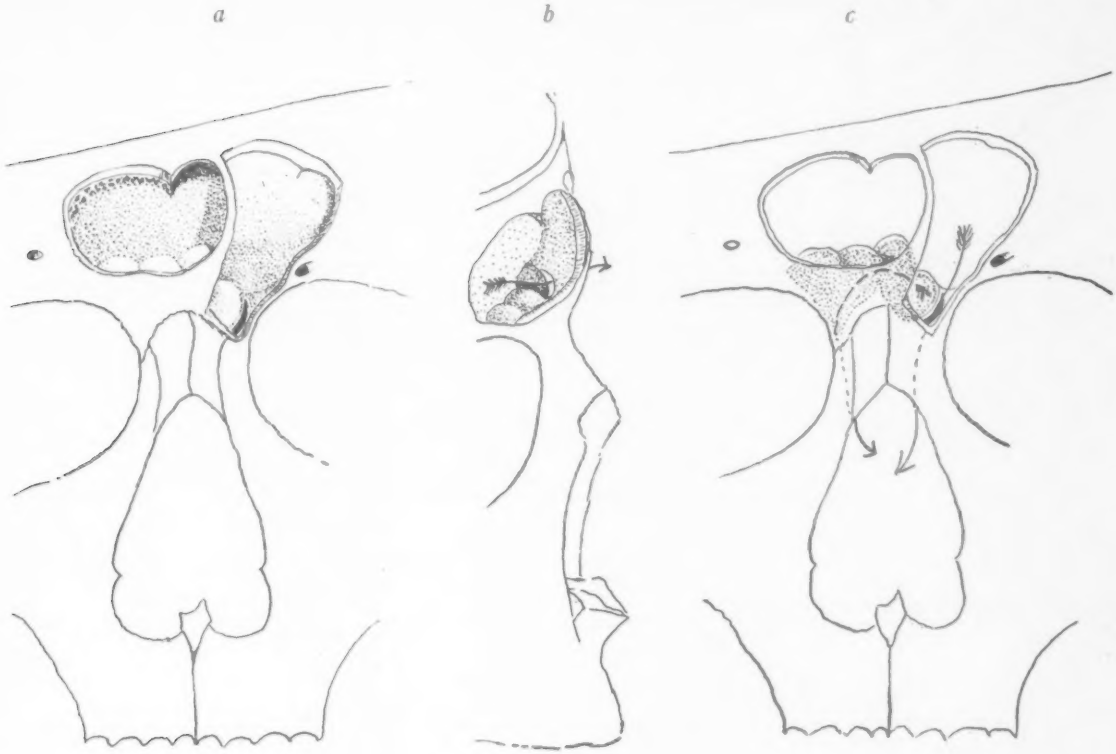


FIG. 6. Frontal, *a*, and lateral, *b*, view to show the anterior and posterior planted frontal sinuses; *c*, shows how posterior planted sinus is extensive and passes into right nasal cavity.

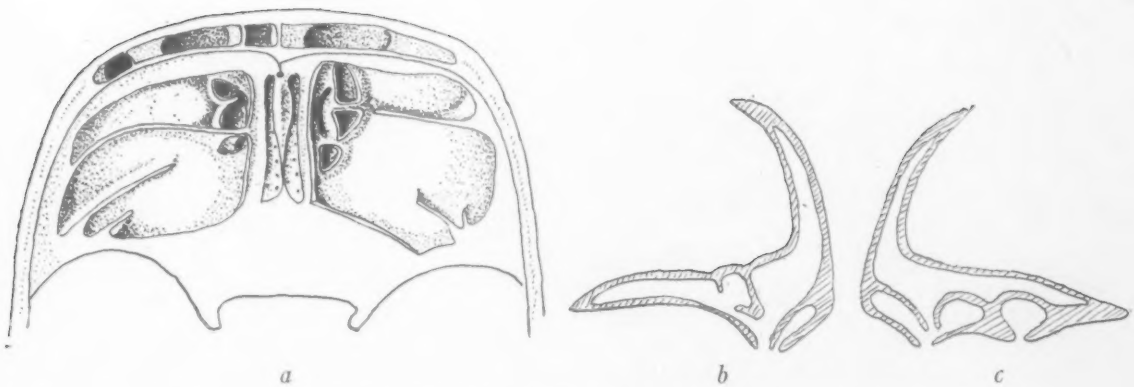


FIG. 7. *a* shows the dissected off roof of the inferiorly placed ethmoidal cell extensions. (See Fig. 2, *a*.) *b* and *c* are diagrams and show the double decker arrangement.

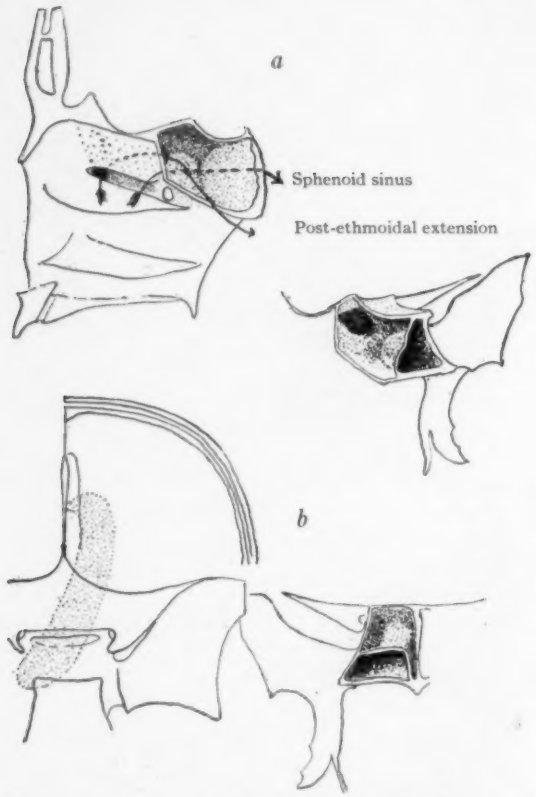


FIG. 8. Large post-ethmoidal cell extending backward over sphenoid sinus of same side (*a*) to terminate above sphenoid sinus on opposite side (*b*).

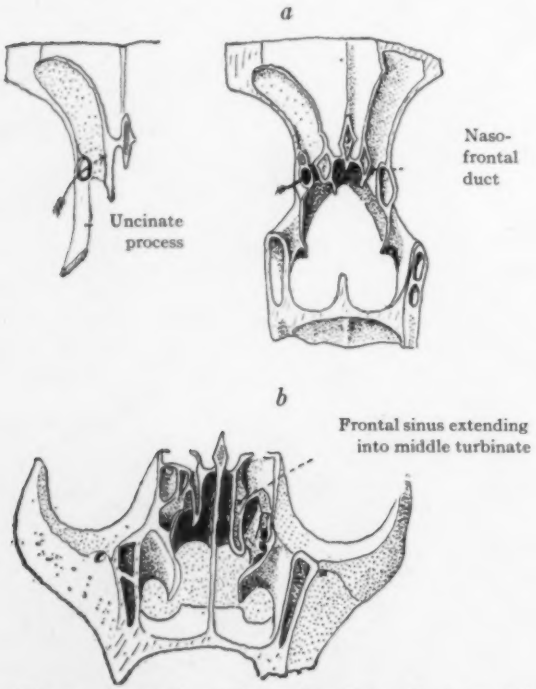


FIG. 9. Coronal section, showing cell from infundibulum passing in front of naso-frontal duct; *a*, looking forward; *b*, looking backward.

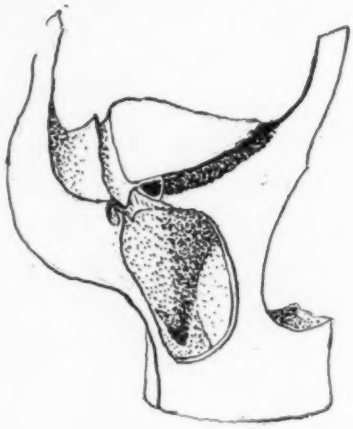


FIG. 10. Facial wall of body of maxilla removed. Ethmoid cell extension (*a*) stippled.

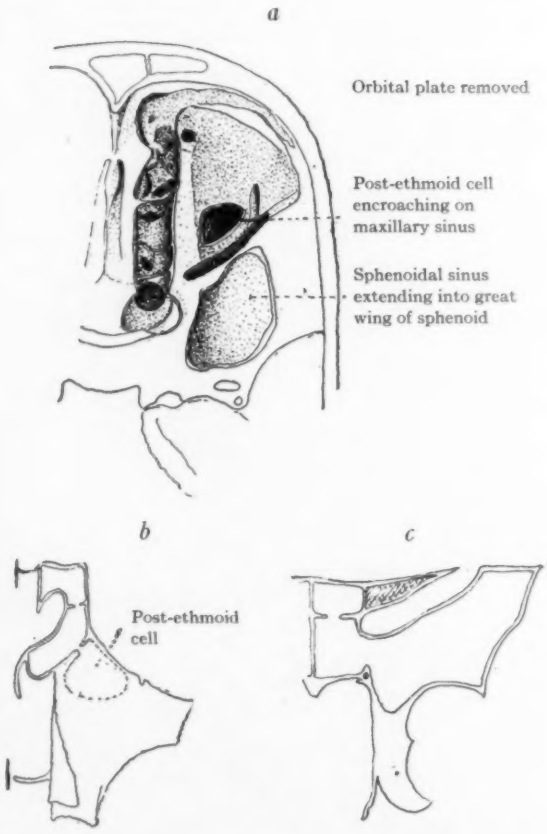


FIG. 11. *a*, orbital surface of superior maxilla exposed; *b* and *c* are schematic pictures and show: *b*, a post-ethmoidal cell extension, and *c*, the sphenoidal extension into great wing.

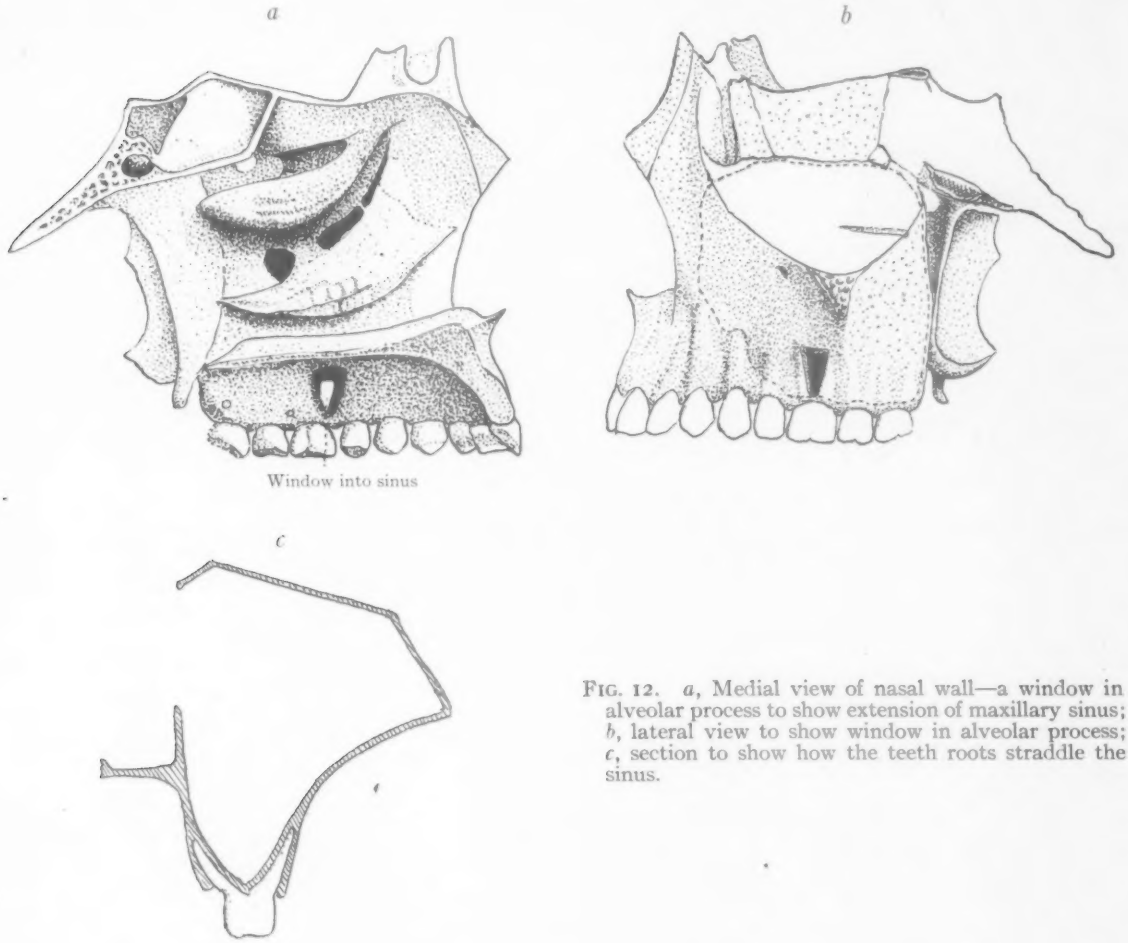


FIG. 12. *a*, Medial view of nasal wall—a window in alveolar process to show extension of maxillary sinus; *b*, lateral view to show window in alveolar process; *c*, section to show how the teeth roots straddle the sinus.

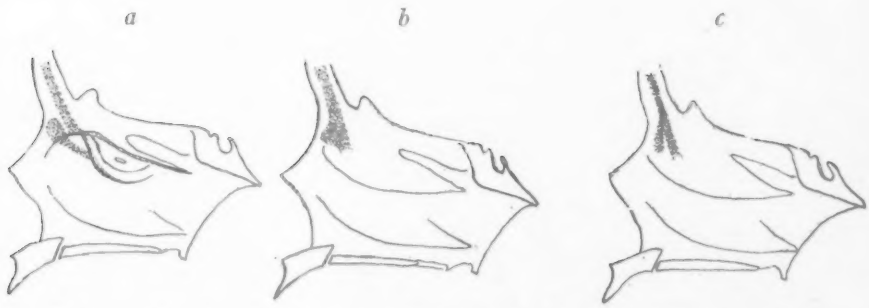


FIG. 13. To show three ways of cellular extension in front of naso-frontal duct. Naso-frontal duct stippled. *a*, Middle turbinate removed.

SOME PRACTICAL POINTS ON THE INTERPRETATION OF ACCESSORY SINUS AND MASTOID PLATES*

BY FREDERICK M. LAW, M.D.

NEW YORK

THE object of this paper is to outline a few practical points in the interpretation of sinus and mastoid plates with the hope that it will bring out considerable discussion so that we may all learn more about this growing branch of roentgenology. It seems hardly necessary, therefore, to go into a detailed description of the technic. Suffice it to say that the anterior posterior sinus plates are made at an angle of 23 degrees from a line from the glabella to the external auditory meatus, and the lateral plates directly through the orbits; in the vertical plates the chin is placed on the plate and the ray directed downward and slightly backward through the sphenoids. The mastoids are made at an angle of 15 degrees posterior-anterior and 15 superior-inferior, with the ear resting on the plate.

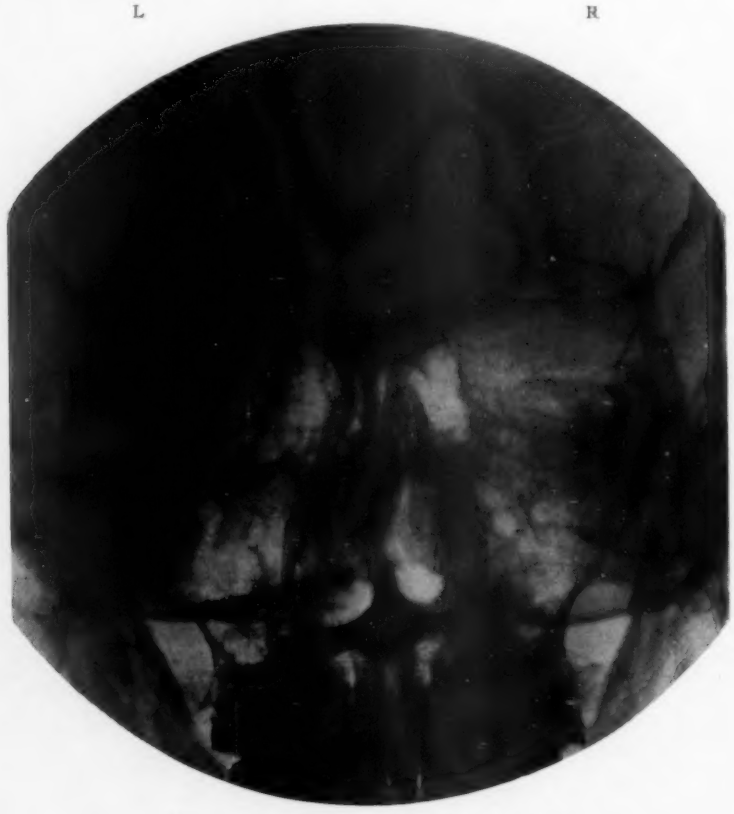


FIG. 1. ABSENCE OF FRONTAL SINUSES.
No shadow of the superior border of the sinus showing.

There are several methods for getting the sphenoids but I prefer the one described above.

For the proper interpretation of the plates it is necessary to know the history, symptoms and the clinical findings before attempting a diagnosis, as these points

*Read at Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, Sept. 27-30, 1916.

may prove the deciding factor in the reading.

Taking up the lateral plate, look first at the frontal sinus. Notice the depth of the frontal and the thickness of the anterior wall. These points will determine the degree of shadow the sinus should cast, if it is normal. A sinus with a thick wall will naturally cast a lighter shadow than the same sinus with a thin wall. Hence a sinus with a thin wall and containing granulations or thin pus will cast the same density of shadow as the same size sinus with a thick wall but clear of pathological material.

Then, too, a sinus with a thick wall which is uneven in density will cast a splotchy shadow which will resemble polyp or granulation tissue. In the case of a single frontal sinus, the bony detail of the solid sinus area will show through the transparent shadow of the single sinus, thus differentiating it from a sinus full of dense material. This with the absence of a sinus outline on the posterior anterior plate proves the absence of a sinus on that side.

Dense polypoid material or tumor will cause a diminution of the shadow of the frontal sinuses and antra in the lateral view, while simple pus causes very little change.

From the lateral view we form some idea of the sellar region so that if we find a suspicious area, we can make stereo plates for that region. All cases referred by the eye surgeon require plates made in all three positions and preferably stereoscopically.

Notice the condition of the teeth, especially with reference to the antrum, and in case of suspicion make films of the teeth.

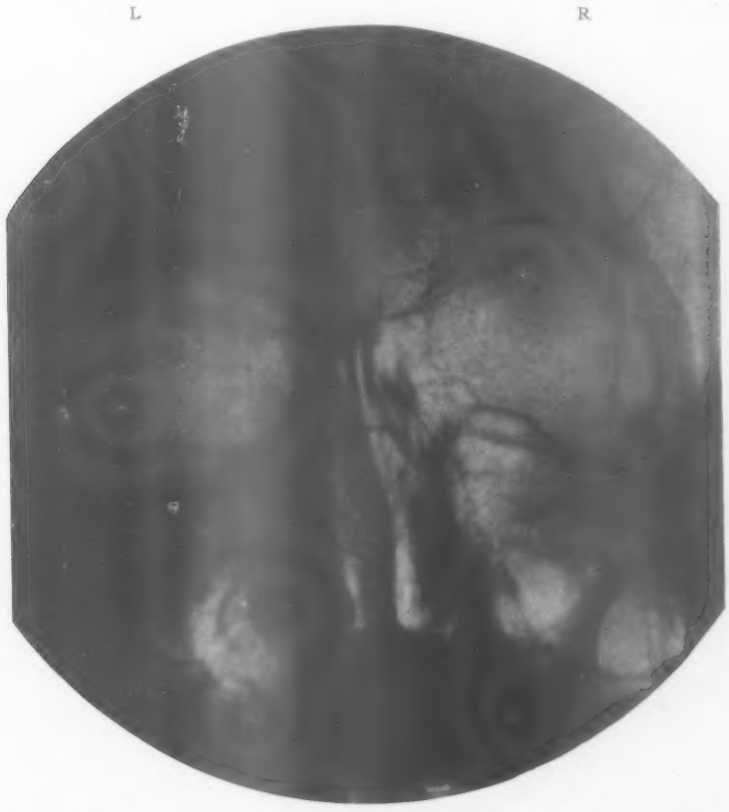


FIG. 2. INVOLVEMENT OF THE LEFT FRONTAL SINUS AND LEFT ETHMOIDS.
Notice the faint outline of the superior border of the left frontal sinus.

Notice the outline of the vault for indications of pressure or change in density.

Now look at the postero-anterior plates and notice the presence or absence of one or both frontal sinuses.

Notice the presence or absence of supra-orbital cells. These will play an important part if an internal operation is decided upon. Another point is the presence or absence of a cell in the crista galli. This may have an influence on the persistence of trouble following a frontal sinus operation.

The difference between granulations or pus can not be determined from the plates alone, but sometimes the history will help. If there is a discharge from the nose, and pus can be detected in the nose, it is reasonable to suppose that the dense shadow in the frontal region is pus. A case in which there are intermittent pain and occasional discharge, will most likely contain dense granulations and some pus.

A discharge of pus from the frontal sinus is liable to be accompanied by a clouding of the ethmoids, while simple granulations or a thickening of the membrane will show a reasonably clear ethmoid region. In the ethmoid region notice the appearance of the cell walls. A haziness in this region does not always indicate pus, as a hypertrophied turbinate bone will cause a hazy appearance, but if the septa are obliterated in the lateral and postero-anterior plates, the condition must be due to pus or tumor formation.

Pressure in the ethmoid region is often the cause of pain and this possibility can be determined from the space in the ethmoid section on the postero-anterior plate. The bony ridges in the walls of the antra are the guide in these regions. The degree

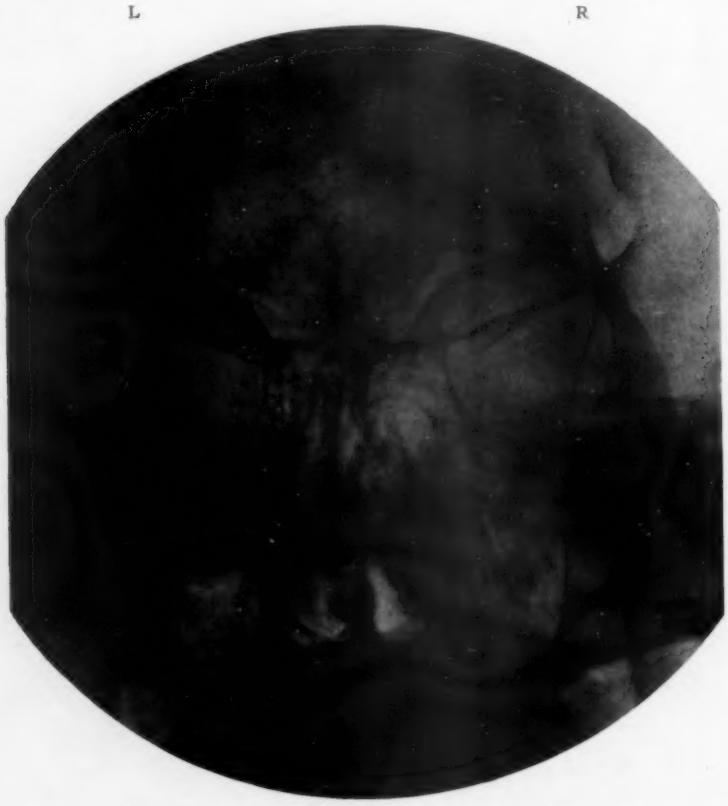


FIG. 3. SHOWING THE ANTRUM EXTENDING BELOW THE FLOOR OF THE NOSE, MAKING DRAINAGE THROUGH THE NOSE IMPOSSIBLE.

of their obliteration determines the amount of pathological material present, although mucoid material casts very little shadow and it is sometimes necessary to puncture the antrum to make a diagnosis between granulations and fluid.

One must consider the position of the floor of the antrum with reference to the floor of the nose to enable the surgeon to determine the method of operating. An antrum with a floor dipping down below the level of the floor of the nose is one which must be drained through the canine fossa in order to secure perfect drainage, as the part below the floor of the nose furnishes a pocket which can not be adequately drained through the nose.

The sphenoids, the most important and inaccessible of the sinuses, must be rayed and examined in all three positions.

The postero-anterior position gives an idea of the transverse size and shape. The lateral position shows the longitudinal size and shape; also its relation to the other sinuses and the sella turcica. The vertical position shows the size and shape of each of the sinuses and their relation to the ethmoids and the sphenoid fissure. In this position can be determined the presence or absence of a large ethmoid cell, a perisphenoid cell, which sometimes lies adjacent to the sphenoid and is the cause of some obscure sinus conditions. For instance, the lateral plate will show a cloudy appearance of the sphenoid sinuses, whereas a view of the vertical plate will prove this shadow to be due to a large opaque ethmoid cell adjacent to the sphenoid, while the sphenoids are clear.

The vertical position will aid the surgeon in determining which side to choose in operating on the pituitary. As a rule the

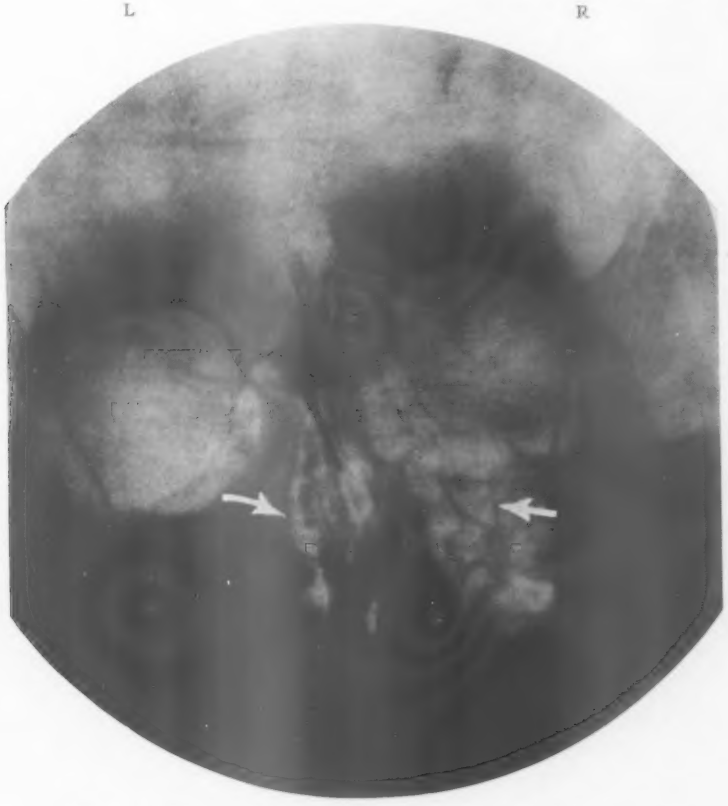


FIG. 4. SHOWING INVOLVEMENT OF THE LEFT ANTRUM.
A large posterior ethmoid cell alongside the sphenoid.

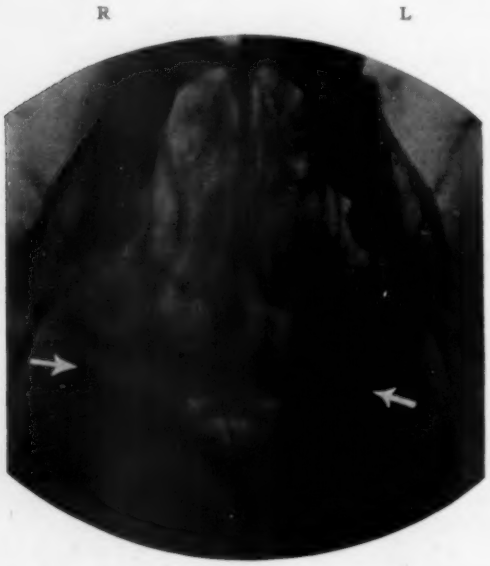


FIG. 5. VERTICAL POSITION OF THE SPHENOIDS SHOWING TWO PERI-SPHENOID CELLS AND A CLEAR ETHMOID REGION.

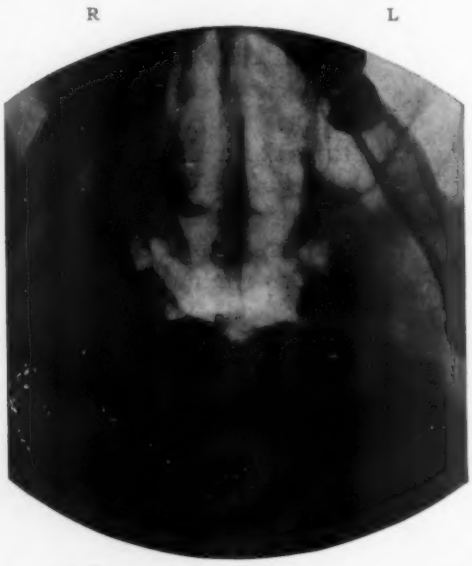


FIG. 6. VERTICAL POSITION, SHOWING INVOLVEMENT OF THE RIGHT ETHMOIDS AND RIGHT ANTRUM. The sphenoids are clear.

sphenoids are not symmetrical and by knowing which is the larger, the surgeon will know which side will allow him the most room for reaching the pituitary body. The shape of the nasal septum can be determined from the posterio-anterior and vertical plates and this will aid the surgeon in operating. Many septa are deflected at the anterior end to such an extent that a visual examination can not be made beyond this area. Knowledge of the extent of the deflection will greatly assist in the operation. The possibility of a previous operation on all the sinuses must be considered, as this will account for a cloudy appearance in some cases. The history will clear up this point.

FIG. 7. THE LEFT MASTOID IS CLEAR, CONSISTING OF LARGE CELLS.

FIG. 8. CLEAR SMALL CELL MASTOID.

MASTOIDS

First notice the external appearance of the mastoid process. If there is any post-auricular edema, the cells are apt to show considerable haze and cloudiness which might be mistaken for inflammatory exudate in the cells. This is often a complication found in furunculosis and can easily lead to an error in the interpretation.

The type of the mastoid should be noted —whether pneumatic, sclerotic, or diploic. The extent of the cells should be noted, also the relative position of the lateral sinus and the emissary vein. If the emissary is large, the surgeon may save considerable annoyance at the operation by knowing its position and size.

The transparency of the bone must be considered. In children the bone is more transparent and will require less pathological change to produce the same degree of cloudiness as in adults where the cortex is hard. The appearance of the lateral sinus is often a good diagnostic point. In the normal pneumatic mastoid the sinus does not show well, only the anterior border of the groove being visible, but any increase in the density of the cells will bring out the outline of the sinus. If the mastoid is completely broken down and the sinus exposed and covered with granulations, no indication of the sinus will be seen; even the anterior wall of the groove will not be visible and the whole mastoid area will show as a blur. Note the appearance of the cell partitions. The degree of detail here will determine the amount of material present.

FIG. 9. THE LEFT MASTOID CONTAINS SOME GRANULATIONS OR PUS. THE CELLS NOT OBLITERATED.

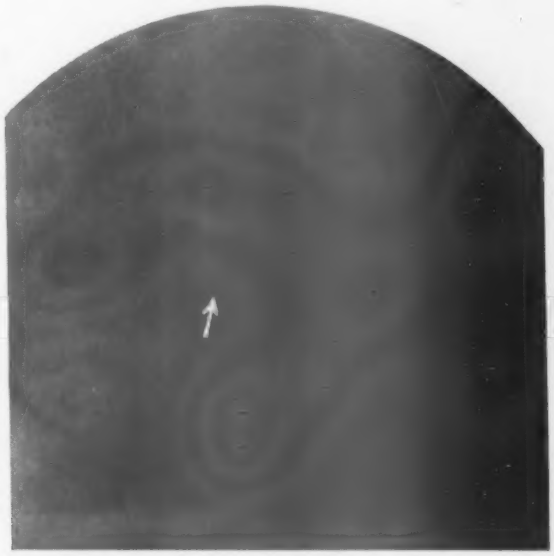


FIG. 10. THE RIGHT MASTOID CONTAINS GRANULATIONS AND PUS WITH A PERI-SINUS ABSCESS OVER AND BELOW THE KNEE OF THE SINUS.

If there are any dark areas in the midst of the white blur, these will indicate either large cells with dense walls or necrotic areas. The condition here can be determined from comparison with the plate of the other side. Note the possibility of the presence of a large corresponding cell in the opposite side. In case there is a corresponding cell, note the outline of the area in the diseased side. Necrosis is usually denoted by a hazy outline, while a cell is usually sharply defined. In the event of the involvement of both sides, dependence must be placed on the history and clinical evidence.

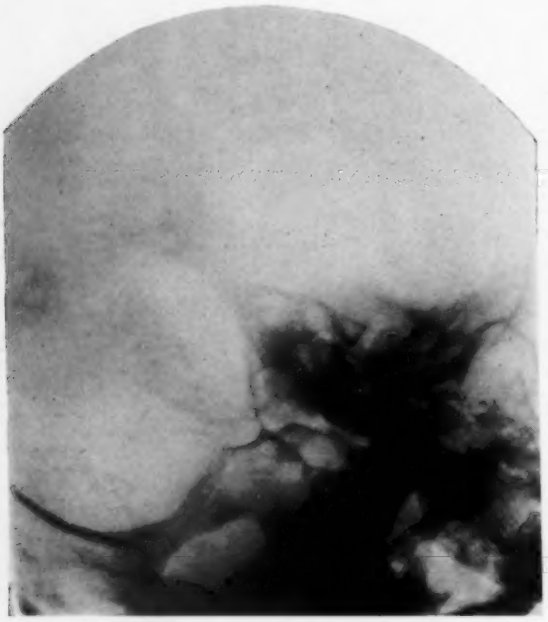


FIG. 11. COMPLETE MASTOID OPERATION. ALL CELLS HAVE BEEN REMOVED.

FIG. 12. THE RIGHT MASTOID SHOWS AN INCOMPLETE MASTOID OPERATION. SOME CELLS REMOVED POSTERIOR AND SUPERIOR TO THE SINUS.

The size of the cells plays an important part in the prognosis. A large pneumatic mastoid with large antrum cells is more liable to clear up without operation than one with small cells. The latter are more liable to clog and stop drainage. This is the reason why so many cases clear up without operation, leading the surgeon to say, "What is the use of the *x*-ray? The plate showed involvement and yet the patient recovered without operating." This could have been prophesied by the roentgen examination.

Examine cases post-operatively. Many cases which have been operated and which have not properly cleared up will reveal cells remaining in the mastoid process. These contain granulations which keep up the discharge and prevent healing.

In closing this enumeration of a few points on sinus and mastoid roentgen examinations let me emphasize the absolute necessity of knowing the history and clinical findings, and the inestimable advantage of a consultation with the surgeon before attempting a complete diagnosis in these conditions.

ROENTGEN RAY FINDINGS IN THE SKULL IN CASES OF BRAIN TUMORS, WITH SPECIAL REFERENCE TO THE PORUS ACUSTICUS*

BY GLADYS L. CARR, M.D.

Roentgenologist, Peter Bent Brigham Hospital and New England Hospital for Women and Children

BOSTON, MASS.

PERSONAL investigation of several hundred cases of brain tumors within the last three years has brought to light information that we roentgenologists may claim as valuable contributions to medical science. I refer to the power of the roentgen ray to demonstrate with accuracy the presence of intracranial tumors and, in a very large percentage of cases, to indicate the location of the lesion.

Surgery, advanced as we know it to be, has nevertheless come to be so dependent in a large number of cases upon the roentgen ray for a positive determination of the effects of intracranial tumors that no study, as we shall presently show, can be complete without the roentgenogram and its accurate interpretation.

No wonder that in the first decade, after the discovery by Professor Roentgen, the skillful hand of the surgeon turned aside the proffered hand of the roentgenologist. We know, alas, but too well how imperfect was our preparation and how defective our fittings. With the years we have not only grown in experience and knowledge, but we have perfected ourselves and our instruments to such a degree as to take our place as dependable agents in medical science.

In 1901, Oppenheim stated that in the majority of cases of brain tumors, the tumor mass could not be demonstrated by the roentgen plate and that the ability of the roentgen ray was much limited,—a fact which still holds true unless the tumor contains lime salts or is of unusual thickness. This limitation, however, does not hold good in its ability to determine the effects produced on the skull by brain tumors, for we can, by the demonstration of the presence of such effects, prove ourselves of the greatest assistance to surgery and the latter now gracefully acknowledges the help we are able to give in arriving with accuracy at an intelligent diagnosis.

Intracranial tumors are divided into those of

1. The anterior fossa.
2. The middle fossa.
3. The posterior fossa.

While it is with tumors of the posterior fossa that we shall be mainly concerned here, it will be necessary to consider somewhat in detail the general pressure effects which may be produced by and be common to tumors in all three fossæ.

I refer to:

1. The enlargement of diploetic channels.
2. The deepening of the arterial grooves.
3. The distention of the sutures.
4. The deepening of the indentations of the inner table of the skull which lodge the arachnoid villi.
5. The convolutional impression atrophy.

These general pressure signs may vary or be entirely absent. In children the effects are largely those of distended sutures and a deepening of the convolutional impressions with thinning and atrophy of the tables of the skull. In adults, however, increase in venous and arterial pressure is the more common finding with rare evidences of distended sutures and deepened impressions. But whatever the general pressure effects common to all three fos-

* Read before the Seventeenth Annual Meeting of the American Roentgen Ray Society, Chicago, Ill., September 27–30, 1916.

sæ may be, the analysis of pressure effects upon the sella shows that those effects vary according to the location of the tumor.

Those tumors close to the skull producing an erosion or a formation of new bone, I cannot take time to discuss here.

Changes in the sella may be caused by direct or indirect pressure. Direct pressure effects are produced by hypophyseal or suprasellar tumors. The diagnosis of these two types of tumors by means of the roentgen ray, as shown by the marked enlargement and deformity of the outline of the sella with a high degree of pressure absorption of the bony walls of the fossa, has become so exact that it cannot be confused with the results produced by pressure of an internal hydrocephalus. I will, therefore, present only the results of my investigations of the indirect pressure effects upon the sella by an internal hydrocephalus produced by tumors in the posterior fossa, that is, tumors below the tentorium cerebelli.

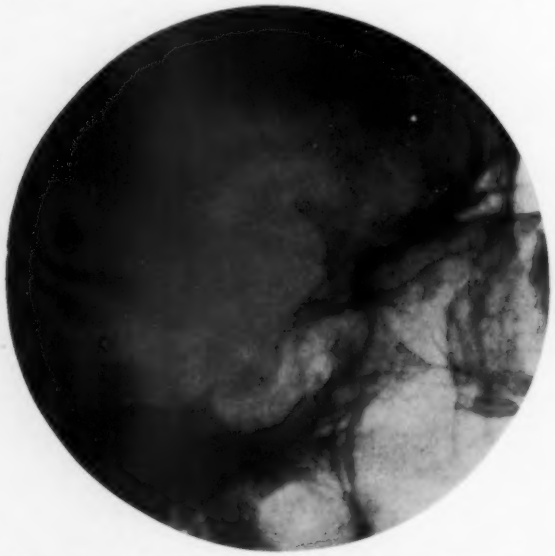


FIG. 1. SELLA SHOWING THE PRESSURE EFFECTS OF AN INTERNAL HYDROCEPHALUS FROM A TUMOR OF THE POSTERIOR FOSSA.

Inclination forward of dorsum sellæ, pressure atrophy of dorsum and posterior clinoid processes. Anterior clinoid processes unaffected; no enlargement at the fossa.

This internal hydrocephalus is the result of blocking of the foramen of Monro through which the fluid of the lateral ventricles passes into the third ventricle. In this connection, however, mention must be made of the fact that in three out of twenty-seven verified cases of tumors of the hemispheres, there were sella changes similar to those produced by the posterior fossa tumors. These findings may be explained by the low positions of the tumors, one having been found in the sphenoidal and temporal lobes of the cerebrum, and two in the basal ganglion.

FIG. 2. NORMAL SELLA.

Changes in the sella vary from a slight haziness of the dorsum sellæ to an enlargement of the fossa, not, however, to the degree seen in the hypophyseal tumors. The dorsum sellæ may be and is in a very large number of cases pressed forward, forming an acute angle with the floor of the fossa. This latter observation was first made by Schüller who considered it to be a finding indicative of tumors of the cerebello-pontine angle. It has, however, been seen as the result of tumors in any part of the skull which by their pressure are able to produce an internal hydrocephalus.

From a slight general haziness of the fossa, the signs may change to those of a very moderate degree of pressure atrophy

of the dorsum sellæ, and even go on later to a destruction of the entire dorsum and posterior clinoid processes, and even to a marked pressure atrophy of the posterior part of the floor of the sella.

The anterior clinoid processes rarely show signs of pressure atrophy, never to the extent shown by the dorsum. The change in the size of the sella is demonstrated by the increase in width of the entrance and deepening of the fossa, the floor in some cases reaching the lower level of the sphenoidal cells.

We have been discussing general pressure effects upon the skull, and the indirect effects upon the sella which may be evidences of tumors of the posterior fossa. According to clinical symptoms they are divided into tumors of the cerebellum and of the cerebello-pontine angle. The first may be considered intra- and the second extracerebellar tumors. We mean by intra those tumors invading the substance of the cerebellum; by extra, of course, those pressing upon and deforming the cerebellum. Thirty-two verified cases of cerebellar tumors were studied and in only three did we fail to find pressure effects upon the sella. In these three cases the distention of the sutures and atrophy of the convolutional impressions were so marked as to account for the negative sella findings.

The other group of tumors in the posterior fossa, and by far the most interesting of all intracranial lesions, arises from the cerebello-pontine angle, either from the dura—and these are the true angle tumors—or from the sheath of the acoustic nerve within the porus acusticus. The latter may become angle tumors by extension. They are generally of slow growth and always begin with manifestations or disturbances of the eighth nerve: first, tinnitus on the side of the lesion, homolateral, continuing for quite a long time with possibly no other symptoms than impairment of hearing on that side together with involvement of the 5th and 9th, or of the 5th and 7th nerves, or of all, with cerebellar incoördination such as dizziness, staggering gait, nystagmus, positive Romberg, and general pressure manifestations, such as headache, vomiting and choked discs.

Secondary pituitary symptoms may be present in cerebellar lesions due to pressure and alteration of the function of the hypophysis. This, together with the changes in the pituitary fossa, has resulted in confusing these with cases of primary pituitary disease.

Weighty as these various findings may seem, they have after all been simply of general import. We now approach a subject matter of far greater moment to us as roentgenologists, and I invite your most careful consideration to my presentation of newly found evidences by the great agency at our command, the roentgenogram, not simply to gain applause for the success of our endeavors but for the far more important purpose of stimulating one and all of you to researches in the same field.

Acoustic tumors generally arise from the nerve where the vestibular branch passes along the floor of the meatus. That these acoustic tumors enlarge the porus acusticus and that this enlargement can be demonstrated by the roentgen ray, was first pointed out, as recently as 1912, by a noted Swedish pathologist.

One of the greatest difficulties we encountered in our efforts to investigate and establish the exact facts for your and our instruction was due to the necessity of obtaining such a position of the patient as would afford an accurate and symmetrical representation of each side of the skull. Various trials to obtain such a correct representation taught us the inexactness of the usual methods. To exactly represent the internal meatus proved quite a difficult task. Many an exposure failed utterly to make visible what we most needed. A slight change in the position of the head of the patient would leave the internal meatus invisible.

We then decided to have recourse to the use of the dry skull. By placing a small circle of wire within the internal meatus

and one within the external meatus, we found that with the skull placed in a certain definite position the internal meatus could be well demonstrated and was found also in a definite relation to the external meatus.

This position was duplicated in the examinations of our patients with satisfactory confirmation of the results we had gained from the use of the dry skull. The patient on the table was placed upon the side, the head being raised from the level of the table and placed exactly in the middle of the end with the ear on the side to be examined as near the centre of the plate as we could possibly adjust it. The head was weighted with sandbags, the chin pressed down close to the plate and toward the sternum. From an incandescent lamp a shadow of the profile was cast upon the plate, a tracing of which was made upon the orange envelope. The tube was then centred over the middle of the cartilaginous portion of the upper ear at a known distance from the plate.

After the exposure of the first side the patient's position was changed so that the head was at the opposite end of the table, with the opposite ear on the plate, and the face in the same relation to and at the same distance from the light in the ceiling. Upon a piece of tracing paper, the size of the orange envelope, was traced the profile which was then transferred to the second roentgen plate and the head adjusted so that the shadow exactly overlay the tracing. In this way a symmetrical picture was obtained of both meati.

The value of the aforesaid profile tracing was not at first apparent. We soon discovered, however, that when in need of the duplication of a roentgenogram, the tracing had an inestimable value. From the results of the methods, as described, we feel justified to state that we are able to obtain an exact comparison of the sizes of the meati.

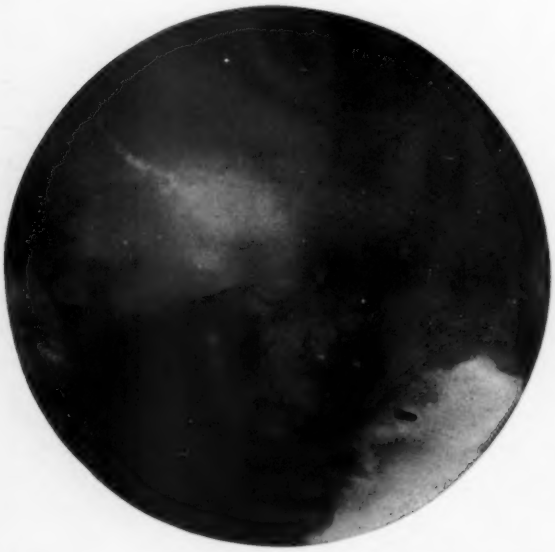


FIG. 3. INTERNAL MEATUS OF PATIENT WITH ACUSTICUS NEUROMA. NORMAL SIDE.

FIG. 4. ABNORMALLY LARGE INTERNAL MEATUS OF PATIENT WITH ACUSTICUS NEUROMA.

Referring to the prints of the porus acusticus, as shown by Henschen, in *Fortschritte*, Vol. XVIII, No. 3, February, 1912, it is evident that the shadows were not symmetrical and, in fact, on the unaffected side there was no representation of the internal meatus. On the affected side, however, the porus acusticus was enlarged

to such an extent that knowing the normal size of the meatus, the enlargement was so definite that it could be very readily discerned. In the porus acusticus, as shown in Henschen's and our own pictures, the shadow of the enlarged internal meatus merged with that of the external meatus so that the two appeared as one oval-shaped shadow. There was, however, a fine curved line across the short diameter which we interpreted as the floor of the porus acusticus.

What are the lessons we can learn from all that has been said?

1. Are general pressure effects on the skull sufficient guides on which to base the diagnosis of an intracranial tumor?

In reply let me say that general pressure effects are not, if taken alone, of sufficient worth, upon which to safely base a dependable diagnosis.

(*a*) We are not justified in basing a diagnosis on the presence alone of enlarged venous channels or enlarged arterial grooves. These may be produced by other conditions than brain tumors, in fact, they are often seen in apparently normal skulls.

(*b*) If, however, the sutures be markedly distended, the convolutional impressions deepened, and the inner table of the skull atrophic, we may draw a reasonable conclusion that there exists an intracranial new-growth.

2. Are the changes in the sella so definite as not to be misleading?

Out of forty-five verified cases of intra- and extracerebellar tumors, there were no sella changes in six. In thirteen verified cases of cerebello-pontine tumors, four showed no sella changes. Out of the six cerebellar cases with no sella changes, four were in children where the sutures were markedly distended and the convolutional impressions of the skull atrophied, which findings might well account for the absence of pressure effects upon the sella.

Of twenty-seven verified tumors of the anterior fossa, all but three showed negative sella findings. That negative results in the sella may be of considerable value is shown by a study of three cases in which the symptoms of a posterior lesion were confused with those of an anterior lesion, the latter being somewhat more prominent that the former. Had there been negative findings in the sella in these cases, there would have been no doubt as to the anterior location of the lesion. The sella, however, showed in these cases pressure effects varying from a slight haziness to a definite pressure atrophy of the dorsum. While the anterior fossa was investigated, the roentgen findings pointed to the posterior fossa; a surgical investigation showed the ventricles to be distended, thus confirming the presence of an internal hydrocephalus just as the roentgenogram had indicated.

FIG. 5. GENERAL PRESSURE CHANGES IN THE SKULL IN THE CASE OF A CEREBELLAR TUMOR WITH INDIRECT PRESSURE EFFECTS IN THE SELLA CONSISTING OF PRESSURE ATROPHY OF THE DORSUM AND POSTERIOR CLINOID PROCESSES.

3. Do tumors elsewhere in the skull, than in the region of the eighth nerve, have the same effects on the porus acusticus as do acoustic neuromas?

This question is answered by the results of investigations of the porus acusticus in eighteen cases. As above stated, in only one case were there evidences of definite enlargement. In several cases there was a variation in size of 1 or 2 mm in diameter, but this variation could not be con-

sidered as of pathological importance, and it is inconceivable that any posterior tumor could enlarge the internal meatus, unless arisen from the eighth nerve within the acoustic opening.

4. Are acoustic tumors always demonstrable by means of the roentgen ray?

In the few cases of acoustic tumors in which the roentgenologist has hitherto coöperated with the pathologist, it has certainly been made evident that the presence of an acoustic tumor is demonstrable by the roentgen ray. Is it not reasonable then to assume that with a large number of cases for investigation and a wider growth in knowledge and experience, the time may be brought near when we may point to the shadow of the porus acusticus with as much understanding as we do now to that of the sella?

It is with some regret that in relation to the porus acusticus, confirmation of our roentgen findings by post mortem examination is not as yet available. In the majority of tumors of the posterior fossa that we have studied, operative procedures have been followed by a generally marked improvement in symptoms. We have failed to duplicate the history of a patient, reported by Henschen in *Fortschritte*, afflicted with an acoustic neuroma with a very much enlarged porus acusticus, and which the roentgen ray had pointed out. An operation was performed upon this patient and a large part of the tumor removed with what was then proclaimed as a remarkable surgical success, and in whom the findings of the roentgen ray were fully confirmed on the day following, unfortunately, by a post mortem examination.

Note: The paper that I have delivered covers an exhaustive study but because of the limit which must necessarily be given to the presentation of the subject here, I beg leave to announce that there will shortly be published this discussion in an enlarged form with the coöperation of Dr. Ernest G. Gray of the Johns Hopkins Hospital.

DISCUSSION ON PAPERS OF DRS. PRENTISS, LAW AND CARR

Dr. H. E. Potter, Chicago.—I was very much interested in Dr. Prentiss' work, because there is so much variation in the sinuses. We see it every day and I have often felt that I ought to learn my anatomy all over again. The sinuses of greatest importance to the nose and throat men are perhaps the frontal sinuses. They can be demonstrated rather easily by the roentgen ray. Next in order is the mastoid. I have been very cautious about the interpretation of roentgenograms with reference to the ethmoid and sphenoid sinuses. In the case of the antrum, the same information can be obtained by transillumination as by roentgenography. That, however, is not the case with the frontal sinuses, the ethmoid and the mastoids.

Dr. Law has shown us some splendid work. I feel that we have all overlooked many cases of ethmoid sinus disease. These sinuses are so important from the standpoint of focal infections that we must know more about them and pay greater attention to them in our examinations. Dr. Prentiss and Dr. Cryer are doing just the sort of work that we need.

Dr. D. R. Bowen, Philadelphia.—Dr. Law and I are not likely to agree as to the vertical position. The position with the plate at the crown, with the central ray entering below the chin, still seems to me to give less distortion (because the plate makes less of an angle with the plane of the sinus) besides being more comfortable for the patient and more positive in fixation.

I have come largely to the conclusion that neither the Pfeiffer position, used by Dr. Law, nor the reverse one described by me is of much value in the diagnosis of sphenoidal sinus empyema. To the surgeon about to operate in this region,

the information to be gained as to topography will, I believe, prove to be of distinct value.

I must disagree with Dr. Potter as to the reliability of sinus transillumination. A series of three cases in which the skull was trephined above the sinus has convinced me that the method is not as reliable as one might wish.

Dr. H. M. Imboden, New York City.—I want to call your attention to the collection of slides we have in the exhibition room. Dr. Prentiss visited us some time ago in New York. He wanted to know whether we were able to demonstrate these cells sufficiently clearly to be of use to the rhinologist. In the past six months or a year we have been making all of our anteroposterior exposures stereoscopically, and during that time our attention has been directed forcibly to what Dr. Caldwell calls the supra-orbital spaces. We thought they were some variation of the frontal sinuses, but Dr. Prentiss told us that these spaces were ethmoidal in origin. The idea occurred to us that by stereoscopic methods we might be able to show some of the simpler forms of variation. We tried a large number of angles, particularly Pfahler's method of projecting rays through the orbit, but we ultimately came back to the stereoscopic method, using the angle previously described. The change in the tube is not made from side to side but up and down, and by slightly increasing the angle on the secondary exposure, we get the best results. In the slides in the exhibit room you will see that we have been able to show what Dr. Prentiss called the double-decker, as well as the triple-decker. Since his visit to us, we have had a case in which we were able to demonstrate an infection of these orbital cells. The operation confirmed our diagnosis.

Dr. Prentiss referred to a variation of the ethmoid, in which the ethmoid was placed in front of the maxillary sinus. Unfortunately, I did not bring this slide, but this is demonstrable by the anteroposterior method and infinitely better by the lateral plate. The anteroposterior stereoscopic method has also the advantage of bringing out the ethmoids with great accuracy. One is able to diagnose lesions in these cells far more easily and far more accurately than with the single plate. The sphenoid can also be very well observed, provided that the space is not blocked by the turbinates. When they are large, the thing is practically hopeless.

As to Dr. Law's paper, I agree with him absolutely. I have used his method, as well as Dr. Bowen's, on the same patient, and I prefer Dr. Law's. As to the posteroanterior position in the stereoscopic method, there seems to be some objection because of the length of the exposure. Our longest exposure is five seconds. The first plate is made in five seconds, the second in four. We do not need a light screen. We get a tube as high as we can get it and we keep it there. The first exposure is made at the regular angle and for the second exposure the angle is slightly increased by shifting the tube up.

Dr. Geo. E. Pfahler, Philadelphia.—This has been a most interesting collection of papers. I enjoyed every one of them and wish I could discuss them all, but for the sake of time I must confine myself to one point and that is the vertical position for the examination of the sphenoid and the posterior ethmoid cells. I took this matter up thoroughly in the preparation of my paper for the Niagara meeting, and I tried to make films inside the mouth, because I believe that by bringing the films as near as possible to the object to be examined we ought to get better results. I failed and I have been revolving the matter in my mind ever since. During the past year I think I have succeeded in getting a solution of the difficulty. Some improvements may have to be made in my method, but it is really very simple and practicable.

I took an ordinary business card, trimmed

off two of its corners and pushed it away back into the mouth against the pharynx. That gave me an idea of the size of the film I could get into the mouth. I then tried an exposure but it was not a success. Why? Because I was getting too many secondary rays on my film. I overcame this secondary ray trouble by placing at the bottom of the film a thin layer of lead. It fits the film exactly. I place the patient practically in the same position Dr. Law does. It gives a little better orientation and some information of the maxillary sinuses. I have described all this in detail and it has been published in the *Laryngoscope*, July, 1916, I think. Slip the film away back in the patient's mouth and then let him hold it in place by biting on it. I use 3 milliamperes of current and a five-second exposure. I get a good result. This gets the ethmoid cells in front, the sphenoid behind and the lateral ethmoid cells on the sides. You get more satisfactory results than you do by greater projection. You must keep in mind where the film is and then where the sphenoid cells are and then project through the sphenoid. The angle must be a little different from Dr. Law's, because the film is further forward. He projects back and I project forward. The patient is sitting and I prop the chin so as to give the necessary support. I bring the cylinder down on top of the head so that everything is firm and the patient cannot move. When the patient is in position, I slip the film in the mouth and make the exposure.

H. W. Dachtler, Toledo, O.—I was particularly interested in Dr. Carr's paper. Three years ago one of our surgeons returned from Dr. Cushing's clinic and made the statement that nothing but hypophyseal tumors could be shown with the *x*-ray, notwithstanding that Schüller, of Vienna, had shown many cases of brain tumor in other locations and had published a monograph on the subject in 1912.

Four years ago, on my return from Vienna, I went over my plates taken in cases of suspected brain tumors and found a number in which the tumor could be definitely located by means of the secondary bone changes produced by the intracranial pressure and the obstruction of the sinuses, and by localized thickening or thinning of the cranium.

Now that Dr. Cushing is recognizing the value of this work of Schüller's and is applying it in the diagnosis and study of brain tumors we may expect to make real progress in the *x*-ray diagnosis of these lesions.

Dr. H. J. Prentiss, Iowa City, Iowa.—In presenting my paper, I did not discuss the sphenoid sinuses because I presumed you did not want it. I discussed these sinuses before the Iowa State Society about three years ago.

In relation to Dr. Law's paper, I have had taken a number of pictures of the supramastoid crest and have found that when this crest almost equaled the direction of the zygomatic arch that the level of the sinus very closely approached the meatus, but when the crest takes a curvilinear course, the lateral sinus makes a relatively short turn and does not encroach on the ear.

Dr. F. M. Law, New York City.—Dr. Potter spoke about transillumination. If you recall the roentgenograms of Dr. Prentiss, you will remember that walls of the sinuses have varying thicknesses, so that when you put a lamp into the mouth or over the eye, you must take this into consideration. Failure to do so will lead you into error. I saw a patient recently who had some discharge from the nose and some headache, but the roentgenogram showed an absence of a frontal sinus. Transillumination would have shown a dark shadow and led to error in diagnosis.

About the vertical position, I forgot to mention that it is very valuable in locating tumor involvements in the middle fossa. It will not show them every time, but in cases with symptoms arising from pres-

sure of a dense mass in the posterior ethmoids and neighboring regions, they are quite liable to show and then the diagnosis is absolute. Nothing is more accessible for diagnosis than the ethmoids. They follow the same rules for interpretation as the mastoids. We have found many variations of the sinuses at the Manhattan Eye, Ear and Throat Hospital, and they were not confined to the negro. There was no rule to follow at all. Whether they have any reference to the voice we have not tried to follow out. As to the position of the head, I make many plates with the patient sitting, with a little stand in front of him, which is movable. It is adjusted to the proper height, the patient is seated in an arm-chair, bends the head forward on the stand and the tube is adjusted for the anteroposterior plate; by turning the head sidewise you make the lateral plate and resting the chin on the plate for the vertical view. There is no shifting of the body, of the tube or the stand; only the patient's head.

Dr. Pfahler says he backs his film with a piece of lead. I wonder if he ever tried backing it with silver. The silver acts as a sort of intensifying screen and reduces the time of exposure.

DR. GLADYS L. CARR, Boston.—Our first plate of a tumor of the porus acusticus was made three years ago. The reason for our adoption of such a definite technic was so that we could say that we had exactly represented the size of the internal meatus. It can be obtained by various other methods but unless we have the internal meatus so many millimeters above the external, we discard the plates, and by putting the patient on the side with the head down, it suited our purpose best. We could duplicate our results. The direction of the ray is down, perpendicular, with no tilting of the plate, and the distance is twenty-four inches from the target to the plate. The centre of the ray is over the middle of the cartilaginous portion of the upper ear. We have a sunlight in the ceiling and we place the table so that the head and feet are the same distance from the light. The patient is placed in the middle of the table. The foot and the head of the table are exactly the same distance from the ceiling light. We take profile tracings and place them in the folders, giving details about the patient.

In closing the discussion, DR. MILLS said:

I think it is wise to limit papers, because that necessitates the essayist confining himself to important factors. A comparison has been made between a diseased stomach as causing symptoms and certain ocular conditions. It is not a fair comparison. In the ocular conditions we have a positively demonstrable cause with a very positively efficient antidote. To answer this discussion would necessarily take up the whole question, whether low position of the stomach is responsible for, or only a factor in, lowered motility and other symptoms present in such cases. On account of the short time at my disposal I cannot go into that matter now.

THE ROENTGEN DEPARTMENT IN WAR TIMES

BY W. A. WILKINS, M.D., C.M.

Captain, Canadian Army Medical Corps; Late Associate Roentgenologist No. 3 Canadian General Hospital British Expeditionary Force, France; Demonstrator of Roentgenology, McGill University; Roentgenologist, Montreal General Hospital; Consulting Roentgenologist, Grey Nuns Convalescent Home

MONTREAL, CANADA

ALTHOUGH almost a year has elapsed since the writer left France, there is no reason to believe that, in so far as roentgenological matters are concerned, conditions have changed materially during that period. The problems associated with this work in the war zone are similar in many respects to those confronting the roentgenologist in civil life. Circumstances associated with war affect our previous routine of life in all its branches, and it is only reasonable to expect that the altered conditions will be evident in the roentgen department. The difference, however, is merely one of detail. On the one hand, there is a preponderance of a certain class of injuries seldom seen in civil life and, on the other, there are altered conditions of administration largely due to environment.

The first problem arises on mobilization, namely, the selection of equipment. This is provided for in the Army Regulations, but circumstances may arise in which a certain unit may have the opportunity to supplement the equipment provided by the army. One of the greatest difficulties in equipping the department for active service is that it may not be possible to know in advance the conditions under which the department will be operated. It may not be known whether the hospital will open out in a town or city where almost any form of electrical energy may be obtainable, or in a field where the department may have to generate its own electricity by whatever means it may have brought with it. The only way to meet this difficulty is to go prepared for anything and everything; in fact, the same may be said for all the work of the department: be prepared for any emergency, including dismantling the department at short notice.

Although many of the hospitals in France are in towns where electrical energy is available, a very great number of them are in the fields, under canvas. If several hospitals are located together or the camp is a large one, the camp will be supplied with electricity by the engineers' branch of the service. One cannot foretell whether his lot will be with such a camp, and it is necessary, therefore, to make provisions independently of any outside supply. This can be accomplished by including a gasoline engine in the equipment. This engine may operate a dynamo to light the entire hospital, or operate the roentgen machine only.

It is advisable to include with the equipment as complete an assortment as possible of spare parts, as the manufacturers are too far away to be of service in the event of breakdown. The advisability of bringing complete sets of duplicate apparatus is to be considered, for the cases in which the apparatus are packed will receive very rough handling from the time they leave the manufacturers until they are opened at their destination in France, and some very essential parts may be damaged. This is especially likely to occur with tubes. They should be taken in large quantities. Of the thirty-two tubes with which we left Canada, nine had been broken when the cases arrived on the field of action. Extra materials, such as copper wire, will be very useful, and a good assortment of tools is essential.

The staff of the department, besides the roentgenologist as the officer in charge,

should consist of the following: a technician preferably of the rank of sergeant; a dark-room attendant, and at least one orderly. If a gasoline engine in the department is directly connected with the machine and started for each exposure made, a machinist will probably be required to ensure satisfactory results. The gasoline engine is best placed in a small lean-to outside the roentgen room, the wires being brought in through the wall. If the gasoline engine operates continuously and independently of the exposures made, the services of a machinist will not be absolutely necessary. Provision must also be made for the clerical work of the department, a very important detail in army life.

The duties of the roentgenologist would consist of administration of the rays, roentgenological examinations and their interpretation. During the last six months of my service in France, the greater part of my time was spent in the operating theatre, where four or five operations would be proceeding at the same time, rendering assistance in interpreting the plates or fluoroscopic examinations. This was necessary to obtain satisfactory results, owing to the large number of cases where foreign bodies had to be localized. Marks were made on the skin surface before operation, but in the event of difficulties arising during the operation, further advice was available, if desired.

One of the features which affect a roentgen department in the field is the necessity of keeping as many beds empty as possible, in order to meet sudden emergencies, as patients may be admitted to the hospital amounting to several hundred at a time. These convoys may be received two or three times or oftener during the twenty-four hours; or the same number of times a week, depending upon circumstances on the firing line. To make room for the new patients, other patients must be discharged or transferred, so that the average duration of a patient's stay in the hospital is short. This tends to make the work of the roentgen department heavy, for the majority of patients are casualties due to foreign bodies. They are accordingly placed under the rays as soon as possible after admission with a view to locating and removing the foreign body and, if the patient is able to travel, sending him over to England for further treatment and convalescence.

In many of the base hospitals where the wounded remain relatively longer, there are heavier installations, although at the time of which I write, coils were almost universal. The general type of apparatus has to be more or less uniform, in order to provide for change of locality and ability to open out rapidly in a new place. Some of the coils are primitive, others highly efficient. Apart from the towns or cities, the sources of energy were gasoline engines, accumulators, or the mains of the camp lighting system. In the latter case, gasoline was generally the fuel employed. Roentgen motor ambulances present no special features, the engine of the motor being used as the driving power for the dynamo. These motor ambulances are complete traveling roentgen departments which admirably serve the Casualty Clearing Stations and Stationary Hospitals, when required.

The average time of the individual exposures is long, but on the whole the results obtained are excellent. A great deal of fluoroscopic work is done, for which there is ample scope owing to the large number of cases passing through a busy department. For roentgenographic purposes plates are used almost exclusively, although there is no reason why they should not be supplanted to some extent by films. The lighter weight and smaller bulk of the latter are two strong recommendations for war service. Bromide paper with intensifying screens was used occasionally at our hospital for small parts, but the results left much to be desired.

In field hospitals, the roentgen department and the operating theatre are generally in sheltered quarters, such as a hut, although the rest of the hospital may be

under canvas. The department should be centrally located, especially in the case of a tent hospital, for in view of the fact that the hospital is spread over a large area, it is by no means a small matter to transport the patients to and from the department. This difficulty may be surmounted by collecting from the wards each day a sufficient number of patients who are able to act as stretcher-bearers. In a large tent hospital it may take the greater part of an hour to accomplish the round trip, consisting in bringing a patient from the ward to the roentgen department and back to the ward again. It will also expedite the work, if on the requisition form provision is made for information concerning whether the patient is able to walk or whether a stretcher is required to bring him to the department. The walking cases can be collected in the department and submitted to a roentgen examination, while the stretcher cases are being brought in. Provision should be made for a waiting room or tent in which cases can await their turn, so that no time may be lost to the department by waiting for cases. Another saving of time would be effected by making arrangements to admit of a patient being examined by the roentgen ray without being removed from the stretcher. This will also save a great deal of unnecessary suffering.

Although the greater part of the work of the roentgen department in the war zone will result from the special class of injuries due to the war, there will also be a certain percentage of cases suffering from the same class of injuries and diseases as seen in civil life, provision for which must not be overlooked by the department.

A CONTRIBUTION TO DENTAL ROENTGENOGRAPHY

BY W. H. MICK, B.SC., M.D.

OMAHA, NEBR.

IN our search for hidden pathology in and about the oral cavity we have used both plates and dental films. In roentgenography of the head or teeth it has been found quite essential to have the head thoroughly fixed. It has been our method in most cases where only the molars and bicuspids are to be shown, to use a plate. In cases of probable fracture we have also used plates to make our records rather than films and, wherever it was possible, the patient was examined with his mouth open, the lower jaw being immobilized by allowing the patient to bite on a cork. At times the mouth is examined both open and closed. In all our plate examinations of the head or teeth the head is fixed by running a simple bandage around the head once, crossing on top of the head, in order to make the best fixation. It is then passed in under the table, drawn firmly, and tied. When the head is fixed, it can be easily rotated, thus making it possible to direct the rays through the head either in a lateral, anteroposterior or oblique direction. We have always used the oblique position, directing the ray between the vertebra and the angle of the jaw, with the plate next to the face on a wedge, raying the head in this oblique position slightly from below. In other words, the ray is directed upward and forward with the head lying downward against a wedge so that the occipital region lies higher than the face. This position exposes both the upper and lower molar and bicuspid regions, and allows us almost as much definition as dental films. It gives a better definition for fractures as well as missing or retained unerupted teeth and of bone cysts or tumors, allowing plenty of room for some of the normal structures to be differentiated clearly.

Unerupted teeth can be shown on films

as clearly as on plates. Where peg-teeth are found with a retained temporary tooth, we are usually able to demonstrate the presence of an unerupted permanent tooth. On the other hand, where temporary teeth are retained alone, the permanent tooth is usually found to be missing, although there are instances where a temporary tooth is retained when part of its root is not absorbed and the permanent tooth is only impacted, making partial pressure on the temporary tooth. The most commonly impacted tooth is the third molar, although I have seen teeth set well in the mouth that assume forward or backward position against the crown or root of its fellow, and are locked there. We should be careful not to call a third molar impacted in its undeveloped state, especially in the lower jaw. These teeth usually begin their direction well toward the crown of the second molar and, as they develop, rotate parallel to it; when they do not rotate, they become impacted. Strictly speaking, impacted third molars are those where the crown is directed toward the second molar, and locks there. There is still another class of impacted third molars which is parallel to the second molar and which even some dentists fail to recognize as impacted teeth. For this reason I have called these locked teeth. In a locked tooth the crown of the third molar becomes thoroughly fixed in the curve of the root just above the crown of the second molar. In many forms of obscure headache with pain and ringing in the ear in our early head examinations for obscure pathology, which were referred to us from the oculists and aurists, we found impacted third molars and, when these were removed, the patient was entirely relieved. The presence of impacted third molars and the relief following removal of the third molar have become so common that some of our most prominent otologists in our city request teeth examinations in connection with roentgen examination of the sinuses, not only in the molar region but in the entire mouth.

Besides locked or impacted third molars we have recently found a form of third molar which I have named irritating third molar, not having seen it described in the literature elsewhere and, for the want of a better name, irritating third molar covers the ground. An irritating third molar assumes the direction opposite to an impacted third molar. Many of our patients with constantly repeated attacks of sore throat have had their tonsils removed under medical advice, or were placed on iodide of potassium without recovery or relief even at the hands of expert throat specialists. When referred to us for a roentgen examination, the third molar was usually found erupted and pointing back, and upon removal of the offending tooth the patient recovered and experienced no further difficulty. In a former paper I have pointed out that dentists too often examine the teeth with the mouth open and physicians too often with the mouth closed. The posterior teeth are invisible by the latter method, it being possible only for the roentgenologist to show the exact position of the third molar in relation to throat structures when the mouth is examined closed. In the absence of relief from many ear or throat troubles, headaches or neuralgia, where it is impossible to show pathology by roentgen or other methods elsewhere, the roentgen ray will usually demonstrate malposition or pathology in or about the teeth. Where the other findings are negative and the third molar has completely erupted and lies in a line with its crown pointing obliquely backward, I have never failed to see relief following removal of such a third molar. Hence it is my firm belief that irritating third molars should be recognized and equally considered along with locked or impacted third molars. Root infections are readily recognized and cast a more hazy shadow than small cysts. Infections rarely involve more than one tooth, while cysts commonly and usually involve two or more teeth.

Infections of the antrum that have be-

come chronic, may extend from the antrum down, and in one instance I have observed the extension of the infection from the antrum of Highmore to where it involved the three molars and both bicuspids. In fact, the patient went to his family dentist stating that his teeth were loose, before consulting a physician. The dentist referred him to the oral surgeon who attempted to trephine the antrum, with the result that the alveolar region gave way and with it all the teeth in the upper jaw to and including the canine. I have seen the same condition, though less extensive, in other cases. While the oral surgeons and dentists speak of root infections, extending up to the antrum, I have been able to demonstrate this to be a fact, but I question whether root infection with a fistula into the antrum is as common as oral surgeons would have us believe. At least in my experience with the patients I have seen, this has not been the case, and when its presence was demonstrated the cases proved to be exceptions rather than the rule, although they may be more numerous than extension of infections from the antrum to the teeth. It would be impossible to state in either case whether infection began in the teeth or in the antrum, although when the antrum has been infected and the bone about it in other directions, involving a number of otherwise healthy teeth, it occurs to me that it is at least reasonable to suppose that the infection has extended from the antrum to the teeth rather than from the teeth to the antrum.

Root infections, as a rule, are small and seldom involve more than one tooth. When they become extensive, a fistula usually forms to the outside rather than an extension upward.

The extension and amount of destruction in pyorrhea casts a very beautiful shadow for record.

Malignant conditions of the jaw, their size, shape, and amount of tissue involved are easily demonstrated by the roentgen ray.

It has been my observation that dentists feel a tooth should be removed, if the broach goes through the crown and peridental membrane. In crown teeth where a root filling can be demonstrated in a root, and the pin of the crown is seen immediately to one side of this, it must not be forgotten that occasionally a root has two canals where it generally and usually has only one, and it is not necessary to conclude that the dentist has filled the root canal and that the broach drilled a hole through the side of the tooth. Where a dentist is in doubt as to whether his broach has gone through the root canal or the side of the tooth it is best for him to leave his broach in position. The canal is much more readily demonstrated than a new opening made by a broach and, besides, it is impossible to tell whether the broach has passed into the tissue beyond unless the broach is left in position while the roentgenogram is being made.

In making my reports on roentgen findings of the teeth I state what in my best judgment these findings mean. I do not attempt to pass judgment as to what the treatment should be, unless the same is discussed with a physician in a problematic way before the cases are referred to the dentist or oral surgeon. My advice to the physician and patient is based on the conviction that the oral surgeon is in a better position to recommend proper treatment. The roentgenologist's concern is to assist in excluding pathology elsewhere about the head and in demonstrating its presence in the teeth. In other words, we attempt to counsel only as to what the probable diagnosis is rather than to suggest the indicated treatment.

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EDITORIALS

STANDARDIZATION IN ROENTGENOLOGICAL PRACTICE

There is no question that the standardization of many phases in connection with the application of roentgen rays for purposes of both examination and treatment has a great many points in its favor. It not only conduces to more regular and more thorough work with the inevitable result of increased efficiency, but it simplifies the proceedings, enables comparisons to be instituted as to the results obtained under well understood conditions and permits of exact repetition of the proceedings, where such is desirable.

Dr. L. L. Jones explained the advantages of such standardized routine measures as instituted by Dr. J. T. Case at the Battle Creek Sanitarium in the administration of opaque meals in the October (1916) number of this journal, pointing out the unquestionable advantages obtained thereby not only for the patients but also in the interests of roentgenology generally and its therapeutic application.

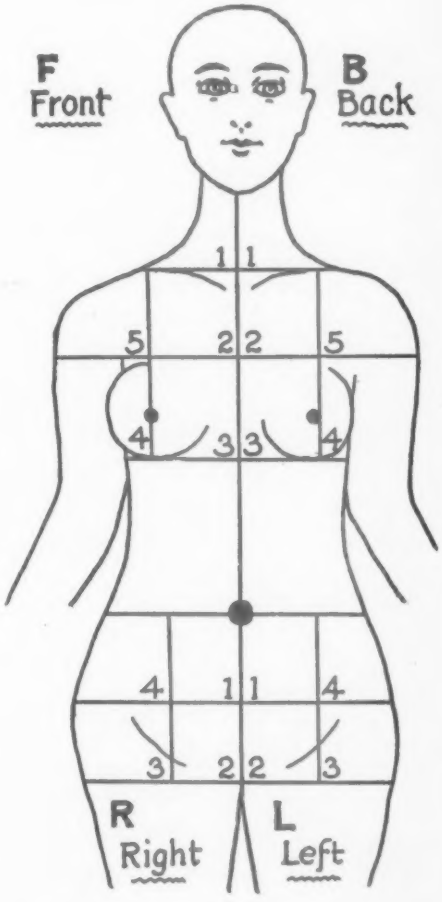

FIG. 1. STANDARDIZED PORTS OF ENTRY.

Dr. Albert Soiland, of Los Angeles, is imbued with the same ideas of the advantages of simplifying and standardizing his method of treatment, having applied his genius to the working out of a simple and efficient scheme in the application of massive doses of roentgen rays through a large number of entrances. His goal is to standardize not only the treatment but also the area treated on a common sense basis, and according to a carefully worked out system provides for ports of entry neither too large nor too small. Dr. Soiland has favored us with the attached sketch, in the evolution of which he genially assures us "much midnight oil, a great many pencils and much valuable paper" have been consumed. He has had this diagram printed on his treatment cards and uses it much in the same way as similar diagrams are used in the clinical diagnosis of pathological conditions.

It will be noticed that the arrangement is quite simple, and while the author's original idea was to paint the squares, as outlined, on the patient's skin, he has found in actual practice that by reason of dividing the body vertically and horizontally through the umbilicus and drawing the remaining lines over unmistakable anatomical landmarks, the various squares are easily memorized and the treatment applied through them without the necessity and inconvenience of marking them on the skin.

Dr. Soiland applies 25 milliampere minutes through 3 mm of aluminum with an 8-inch skin distance and a 10-inch spark gap, which furnishes precisely 10 X units. His usual method is to give 50 milliampere minutes at one time over one of these squares, marking the fact on the diagram. This gives a good dark pigmentation, and although it is accompanied by some nausea, it accomplishes the effect that, in his opinion, a massive dose should have. He carefully refrains from striking the same area within thirty days. Instead of leather he uses quilted cotton mats over the skin. They are clean and, of course, cut large enough to protect against untoward electrical discharges.

It is also satisfactory to note in this connection that the doctor has standardized his system of charges to the patients, making a uniform charge of five dollars for one treatment of 25 milliampere minutes and higher charges in exact proportion to the more massive doses. He finds that this arrangement works to the satisfaction of all concerned.

Metastatic Dangers

It has long been a recognized fact that the growth of cancerous tissue is stimulated by an additional trauma, but this fact, important though it is for the well-being and even life of the patients, has not been sufficiently heeded by surgeons who resort to the excision of a small piece of suspected tissue in order to obtain a pathological report, upon which to determine the indication for operative interference.

It appears that Commissioner Emerson, the Health Officer of New York, went even so far as to specially recommend biopsy of such growths, as was recently animadverted upon in the *Medical Record* which correctly pointed out the appalling danger lurking in such proceedings on account of the metastatic growths to which such unwarranted interference gave rise in the event of the disturbed tissue being cancerous.

The subject is of peculiar interest to roentgenologists who are tempted to furnish proof of the cancerous condition they may claim to have relieved by the application of roentgen rays. To furnish such proof, they are apt to excise a small portion of the suspected lesion before treatment in order to have the malignant nature of the specimen microscopically confirmed, ignoring the fact that by doing so they may set up metastatic foci in neighboring or distant parts of the body that may ultimately endanger the patient's life.

From a Utopian point of view it would no doubt be desirable to adduce evidence of a particular roentgen treatment having effected a cure or improvement of a condition which was unquestionably of a cancerous nature instead of leaving it open to doubt and adverse criticism whether there was malignancy or not; but the patient's welfare will not allow us to do this, and the roentgenologist should rather smart under the suspicion of claiming improvement of a condition which may possibly not have been malignant, than under the accusation of having jeopardized the future health and life of his patient for the sake of an academic controversy. A diagnosis of cancer should be made on other than microscopic grounds, if it necessitates the removal of living tissue.

England's Roentgen Industry and the War

While this journal is not devoted to the commercial exploitation of any particular make of roentgen apparatus or to the recommendation of apparatus made in any particular country, we accede to the request of Mr. G. N. Dunlop, the secretary of the British Electrical and Allied Manufacturers Association, of London, to acquaint our readers with the fact that a section of that association has been formed enrolling British manufacturers of roentgenological and electro-medical apparatus with the object of improving the status and prospects of that industry in England.

Mr. Dunlop explains in a circular letter that before the war the major part of this class of apparatus used in England has been made in Germany and other countries, but since that epoch-making event great strides have been made by individual British manufacturers to supplant those countries. But they have been laboring under a serious disadvantage owing to lack of cooperation by which to meet the keen competition which exists in the world market, and the newly formed section hopes to offer a means whereby the manufacturers of British electro-medical instruments may be systematized and fostered. The secretary states that the section has already been able to coöperate with the English, government in research work connected with the improvement of some essential instruments, and he hopes that this will be a preliminary to wider investigation.

This country is justly proud of the excellence of the roentgen equipments it produces, and there is no reason why England, too, should not be able to emancipate itself from foreign competition. As long as British manufacturers can produce equal or superior goods at the same figures as their competitors, their entrance into the world market deserves the cordial welcome of the interested parties.

NOTICE

The Eighteenth Annual Meeting of The American Roentgen Ray Society will be held at Waldorf-Astoria Hotel, New York, Sept. 20-22, 1917.

TRANSLATIONS & ABSTRACTS

HOMANS, JOHN: A Study of the Symptoms and Treatment of Congenital Transduodenal Bands. (*Boston Med. and Surg. Jour.*, Vol. CLXXV, No. 19, Nov. 9, 1916, p. 665.)

Searching for suitable material at the Peter Brent Brigham Hospital, of Boston, the author has encountered eleven cases in which definite bands passing from the gallbladder and liver across the duodenum have been found and in which gastric or duodenal ulcers or gallbladder disease have been held to be absent. The lesion can be best described by quoting from the operative records and reproducing a sketch made at operation (Fig. 1):

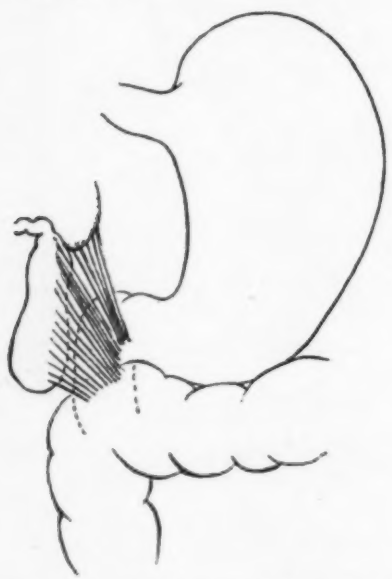

FIG. 1. DIAGRAM TAKEN FROM SKETCH MADE AT OPERATION. CASE XI, D.T.

The gallbladder is attached to the hepatic flexure by a broad, flat band of adhesions passing across the duodenum. A second smaller band passes from the liver to the lower border of the pylorus indenting the duodenum slightly.

"There were a number of adhesions, apparently of a congenital type, passing between the lower part of the gallbladder and the cystic duct across the duodenum to the region of the head of the pancreas. These did not appear to indent or constrict the duodenum. There was another band of adhesions, narrow and rather tight, which passed from a point just proximal to the pylorus to the liver itself rather high up beneath the inner part of the right lobe mesial to the gallbladder. These adhesions made a slight constriction in the upper part of the duodenum at about the point indicated in the *x*-ray as the seat of ulcer. After dividing these adhesions it was possible to feel exactly the whole duodenum and pyloric region, and no induration or deformity could be made out."

Or again:

"At a point just below the pylorus a very broad band of what appeared to be congenital adhesions attached to the gallbladder, from a point beginning at the cystic duct downward for perhaps an inch and a half toward the fundus, to the hepatic flexure of the large intestine and to the inferior surface of the pylorus just above this point."

This is the description taken from another case:

"Extending from the region of the head of the pancreas to the lower border of the pylorus was a small, scar-like band. Where this band came to the pylorus, there was a larger and more stellate scar which, however, was not in the stomach wall but in the peritoneum with fat under it, evidently not the result of an ulcer but an old congenital band. From this scar ran a much stronger, rather funnel-shaped band across the junction of the first and second portion of the duodenum to the neck of the gallbladder where it finally spread out over half the surface of the gallbladder. This band made a pronounced indentation in the duodenum, evidently causing a kink if not an absolute obstruction."

It is not pretended that these bands are pathologic or necessarily give rise to any symptoms, and the object of the author's investigations was to throw light upon the question whether they give rise to symptoms which would cause them to be considered a pathological entity with a definite course, symptomatology and treatment.

The general character of the patients' complaints tends to resemble that of ulcer or gallbladder disease, but gives the impression of a reflex symptom complex. In respect to intermittency, the symptoms resemble gallstones or chronic appendicitis rather than ulcer. In respect to food relief, the symptoms resemble those of gallstones and chronic appendicitis rather than gastric or duodenal ulcer, but when food relief is present it stimulates duodenal or

pyloric ulcer in type. In respect to vomiting the disease is rather like gastric ulcer or gallstones. In respect to bleeding, band cases present negative findings.

The clinical diagnoses made in these eleven cases may be grouped as follows:

Duodenal ulcer: 4 times, twice bracketed with band;

Gallstones or cholecystitis: 4 times, bracketed with gastric ulcer once, with band once, and with adhesions once;

Cancer: once.

Gastric or pyloric ulcer: once and cancer bracketed with it;

Chronic appendicitis, ulcer or constipation: once.

It appears, therefore, that cholecystitis, duodenal and gastric ulcers are not likely to be mistaken for bands, but that bands may simulate the appearances of these other lesions, especially duodenal ulcer and cholecystitis.

Under these circumstances it was interesting to see what light roentgen examinations were able to throw on this condition. Eight of the cases were studied roentgenologically and the findings may be used as a basis for further study. There were three instances of duodenal defects, two of dilatation of the upper duodenum, one of hour-glass stomach, one of normal duodenum with gastric hyperperistalsis and one of normal duodenum with atonic stomach. As a rule, bismuth passed through the duodenum so rapidly as to make a record of duodenal irregularities difficult to obtain, but the pylorus was generally regular in outline. The roentgen findings are, therefore, much more like those of duodenal than gastric ulcer, the one exception being the instance of gastrospasm which, of course, is more common as an accompaniment of the latter than the former. But even here the spasm was so variable that, not being accompanied by any typical ulcer defect, it was correctly attributed before operation to reflex causes outside the stomach.

The author appends the protocols of the histories and operations, the following details representing the more important points:

Case I.—Hysterical woman of 38, suffering from indigestion, constipation, gastrospasm, vomiting, loss of weight. Diagnosis: cholecystitis with adhesions.

Roentgen Examination: Long, hook-shaped stomach, slight atony, normal pylorus and duodenum.

Operative Findings: Normal stomach, tight pylorus, duodenum rather thick and firm, adhesions across duodenum to head of pancreas. Operation gave first partial, then complete relief.

Case II.—Worn-out old woman of 67. Radiating pain in pubic region; constipation; no free acid.

Roentgen Examination: Low, dilated, atonic stomach; regular pylorus and duodenum.

Operation: General visceroptosis. First portion of duodenum dilated. Band containing fat and blood vessels passing from gallbladder to hepatic flexure and lower border of pylorus constricting duodenum.

Operation gave improvement, but death ensued soon afterward from unknown causes.

Case III.—Neurotic woman of 41. Distress one or more hours after eating, burning and dull epigastric pain. Hunger feeling. Vomiting present but not of food eaten. Hyperacidity. Diagnosis: Gallstones or gastric ulcer.

Roentgen Examination: Hypertonic stomach, deep peristalsis, pylorus and duodenum defined and regular.

Operative Findings: Normal gallbladder and stomach, a broad band containing fat and blood vessels passes from gallbladder (indenting duodenum) to inferior border of pylorus and on to head of pancreas. No evidence of duodenal ulcer. Operative treatment resulted in gradual relief.

Case IV.—Normal appearing girl of 19. Sour stomach, dull ache in epigastrium. Diagnosis: Cholecystitis or duodenal band.

Roentgen Examination: Hour-glass stomach, deep peristalsis, normal pylorus and duodenum.

Operative Findings: Normal gallbladder and stomach; broad band passes from gallbladder across duodenum, without indenting it, to lower side of pylorus. Operative treatment finally resulted in almost complete relief.

Case V.—Stout, pallid man of 41. Indigestion for 20 years, colicky pains, fainting attacks, food relief, occasional vomiting. HCl increased or absent. Diagnosis: Duodenal ulcer or appendicitis.

Roentgen Examination: Gastric hyperperistalsis, irregularity of first portion of duodenum.

Operation: Friable gastric wall with no evidence of ulcer, small tight pylorus, a stellate scar associated with vascular adhesions passing from lower surface of liver across duodenum which was firmly fixed to liver. No induration

FIG. 2. CASE VIII. HUGE DILATATION OF DUODENUM ASSOCIATED WITH A BAND.

First portion of duodenum larger than pyloric antrum.

of duodenal wall. Scar thought to be an old ulcer. After operation, death resulted from pneumonia. At autopsy, there was no evidence of duodenal ulcer even on careful microscopic section of the duodenal wall.

CASE VI.—Male, 56. Sour stomach for twenty years. Early morning pain starting at umbilicus and radiating to left, followed by dull grinding sensation. Hyperacidity. Diagnosis: Chronic duodenal ulcer or band and cancer elsewhere in abdomen.

Roentgen Examination: Prompt emptying, normal outline of stomach and duodenum, stasis in second portion of latter.

Operative Findings: Normal stomach, typical fan-shaped band from gallbladder across duodenum to head of pancreas. Duodenum compressed but not creased. Inoperable cancer of pancreas. Operative division of band was followed by relief for several weeks. Death occurred three months later.

CASE VII.—Neurotic man of 30. Gastric discomfort after meals. Dull pain to right of umbilicus. Vomiting. No roentgen examination at this clinic. Diagnosis: Chronic appendicitis, gastric ulcer or constipation.

Operative Findings: Normal stomach, light band from middle of gallbladder across duodenum; appendix looking normal. After operative division of band and appendicectomy there was slight improvement.

CASE VIII.—Stout man of 50, looking older. Discomfort and eructation after meals. Constant hunger. Diarrhea. Loss of weight. Anacidity. Diagnosis: Chronic ulcer with question of cancer.

Roentgen Examination: Hyperperistalsis and much dilated pylorus and first portion of duodenum. Beyond this point, duodenum empties rapidly and can not be outlined (Fig. 2).

Operative Findings: Stomach normal, pylorus large, first portion of duodenum enormous, broad band from gallbladder across duodenum to hepatic flexure, compressing the duodenum without creasing. Division of band resulted in steady improvement.

CASE IX.—Male, 42, alcoholic. Pain and rumbling after eating and at night. Loss of weight; hypersecretion. Diagnosis: Duodenal ulcer.

Roentgen Examination: Normal stomach, no stasis, defect in anterior upper portion of duodenum (Fig. 3). Rapid passage of food through duodenum. Excision of band gave

FIG. 3. CASE IX. BEFORE OPERATION.

Duodenal defect associated with deforming band.

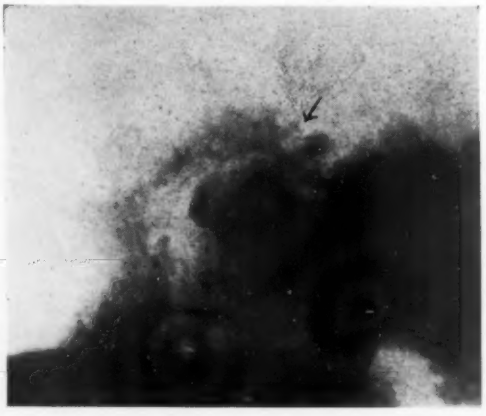

FIG. 4. CASE IX. AFTER OPERATION.

Note increase in deformity following operation, as compared with Fig. 3. The band has been excised.

immediate improvement but not complete relief. A roentgen examination three weeks after the operation showed duodenum more deformed than before (Fig. 4).

CASE X.—Stout woman of 53, free eater. Epigastric pain, relieved by careful dieting. Diagnosis: Gallstones.

Roentgen Examination: This was only made for suspected gallstones.

Operative Findings: Normal gallbladder and stomach. A broad, fan-shaped band passes from gallbladder across the duodenum to lower

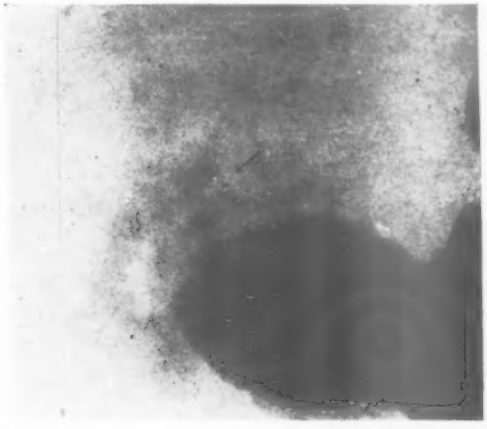

FIG. 5. CASE. XI. DUODENAL DEFECT ASSOCIATED WITH A DEFORMING BAND IN SAME PATIENT FROM WHOM SKETCH (Fig. 1) WAS TAKEN AT OPERATION.

The duodenum was opened and no evidence of ulcer found.

side of pylorus. Division of band finally resulted in relief.

CASE XI.—Male, 49. Pain after eating. Loss of weight. Food relief. Diagnosis: Duodenal ulcer, question of band.

Roentgen Examination: Gastric hyperperistalsis. Rapid passage of food through first portion of duodenum (Fig. 5).

Operative Findings: Normal stomach, band from liver and gallbladder, crossing and indenting duodenum, to lower side of pylorus (Fig. 1). Four months after operation, the patient enjoyed perfect health.

A great many surgeons who have met these bands at operation have undoubtedly regarded them as a chance finding which, though unimportant, has saved them from the ignominy of a negative exploration. Moreover, owing to the very generally "reflex" character of the symptoms in such cases, operators are perhaps inclined, in addition to dividing the band, to remove a questionably abnormal appendix or gallbladder, and are thus at a loss to place the credit for any subsequent improvement.

Summing up his observations, the author concludes:

(1) Congenital transduodenal bands may be responsible for symptoms "reflex" in type which have a definite family resemblance in spite of considerable divergence;

(2) The roentgen findings generally indicate duodenal spasm or dilatation of some portion of the duodenum;

(3) Division of the bands and appropriate treatment of raw surfaces are fairly curative, although plastic widening of the duodenal opening will probably give the best results;

(4) Judging from their frequent observation at autopsies, these bands are not necessarily pathologic, but may be responsible for digestive disturbances having a recognizable symptomatology, a prolonged course, and appropriate operative treatment.

GRAESSNER. The Roentgenological Demonstration of Spina Bifida Occulta. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 151.)

Spina bifida occulta may often be demonstrated roentgenologically. Graessner found that every tenth person has a gap at the fifth lumbar or first sacral vertebra. He also discusses the literature on the subject. The affection occurs more frequently than has been assumed, but he is not prepared to say whether myelodysplasia, of which the splitting of the lumbar and sacral bones is only a symptom, is the actual cause of all the affections and complaints enumerated. It is a fact, however, that myelodysplasia does not present any external signs in the majority of cases, and in many of them does not even cause any pathological manifestations.

EBELER, F. Uterine Prolapse and Spina Bifida Occulta. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 151.)

Roentgenological examinations have caused Ebeler to support the views of Buerger who holds that in many cases of uterine prolapse similar etiological conditions prevail as Veit

described in a case of spina bifida occulta. Frequently there appear to be more or less severe injuries to the nerve cords which render the muscular apparatus of the pelvic floor insufficient to such an extent that a slight impulse is sufficient to cause a prolapse.

THOMAS, B. A. Vasopuncture and Medication for Seminal Vesiculitis. (*Surgery, Gynecology and Obstetrics*, January, 1917, Vol. XXIV, p. 68.)

This paper deals with the technic of the operation and results following the injection of medication, usually silver salts, into the vesicles. Roentgenograms by Dr. H. K. Pancoast have been freely employed in the author's work in order to make sure that the injections have been properly carried out, and for the diagnosis of certain abnormal conditions of the seminal vesicles.

MEYER, ARTHUR. Isolated Fractures of the Transverse Lumbar Processes, with Special Reference to the Roentgenological Differential Diagnosis. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 152.)

This contribution describes six observations made by the author and 27 collected from the literature, and deals with the effect of the muscles on the fracture, according to age and sex, the seat of the fracture and other symptoms. The technic of the roentgenological exposure, which is by no means easy and may be difficult of interpretation in the event of certain coincidences, is described in detail. The interpretation should pay special attention to the psoas margin, renal concrements, narrowness of the transverse processes, the shadow of the articular processes, the variableness of a lumbar rib, the anomaly of an oval foramen in the transverse processes and a persisting epiphyseal line of the transverse processes.

PFAHLER, GEO. E. The Treatment of Malignant Disease by Means of Deep Roentgenotherapy and Electrothermic Coagulation. (*Surgery, Gynecology and Obstetrics*, January, 1917, Vol. XXIV, p. 14.)

After a preliminary discussion of the theory of the effects of roentgen rays on malignant tissue, the author describes his technic, the details of which have been abstracted in previous issues of this journal. As most of our readers know, Pfahler was one of the earliest users of filters in roentgenotherapy. At the present time, the author uses six millimeters of aluminum or its equivalent in deep work. He generally uses four millimeters of glass and two millimeters of aluminum. Glass has the advantage of serving as a filter and also an insulator and is less affected by heat. Pfahler emphasizes that this does not prevent or eliminate the possibility of *x*-ray burns. One can still burn the skin seriously through any amount of filtration. It does, however, permit the administration of at least ten times the quantity of rays into the deeper tissues, and when this filtration effect is added to the crossfiring effect, we can increase our deep results perhaps one hundred times as much as we could do ten or fifteen years ago.

As to crossfiring, Pfahler lays stress upon increasing the number of portals of entry to the maximum within reasonable limits, but one should be careful to keep within practical bounds.

The greatest field of usefulness of deep roentgenotherapy is in the postoperative treatment of malignant disease. This does not mean that a surgeon can cut away at random masses of malignant tissue, and leave definite malignant tissue behind, and then expect to control it and get the patient well by means of deep roentgenotherapy. It means that when the surgeon does a clean surgical operation, such as he has been doing, the results will be tremendously improved if he would add the deep roentgenotherapy in postoperative treatment. Roentgenotherapy may also be combined with electrothermic coagulation to great advantage. Roentgenotherapy may also be combined with radiotherapy, but the roentgen rays and radium should never be applied through the same surface of skin or mucous membrane, for we are using two agents having the same general physiological effects on the tissues, and by doubling this effect serious results may occur in the form of burns, which will prevent the future proper treatment of the patient. Surgery, electrothermic coagulation, roentgen rays, and radium may all be applied in the same case to advantage in some instances.

The remainder of the article gives the classi-

fication of cases and results obtained. It has been the author's experience that sarcoma yields very much more readily to deep roentgenotherapy than does carcinoma. In fact, his experience leads him to believe recovery possible in at least fifty per cent. of the cases of sarcoma.

CRAMER, C. On Abbott's Treatment of Scoliosis. (Tenth Anniversary of the Cologne Medical Academy. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 152.)

Cramer reports his experience on 81 cases. One of his roentgenograms of a right dorsal scoliosis, after wearing a plaster jacket, demonstrates the apparent clinical overcorrection which is explained by exaggerated lumbar scoliosis. The method is intended to overcome the protruding eminence, but the amount of trouble and expense it entails stands in the way of its being accepted as a general method of treatment.

BRYANT, JOHN. The Ileocecal Valve and the Chronic Intestinal Invalid. (*Boston Med. and Surg. Jour.*, Oct. 19, 1916, Vol. CLXXV, p. 572.)

Bryant believes that the normal ileocecal valve is incompetent; that it is an active muscular, as well as a passive mechanical structure; and that it is responsive both to nervous and chemical stimuli. It may be rendered incompetent by destructive distensive pressure from above or below, or both. He is also convinced that incompetency, when found, may not be dismissed as harmless and unimportant, or merely as a symptom pointing to something else.

The following questions are raised by the author: What is the real frequency of incompetence? When found, is it congenital or acquired, and in what proportion? How often is medical treatment adequate? May it ever restore the valve to actual competence?

The author believes that his personal experience justifies the assertion that, when present, ileocecal valve incompetence should be treated as an undesirable pathologic entity; an entity, however, usually responsive to intelligent treatment. Bryant also believes that adequate medical treatment may even restore the valve to complete competence. This is contrary to the opinion of Case, who has said that the ileocecal valve once incompetent is always incompetent.

Bryant states that the diagnosis of ileocecal valve incompetency is absolute by means of roentgenoscopy. This remark is susceptible of some criticism. Kellogg and Case do not accept this statement.

The author's concluding remarks are worth quoting. "In the present stage of development of the science, it is as inexcusable to omit roentgen study of an intestinal case which does not readily react to treatment, as it is to neglect a Wassermann test in an appropriate case. Given a case with a chronic intestinal history, with local pain, coarse crepitation on pressure over the right iliac fossa, excessive gas formation not easily relieved, constipation, stasis, and evidences of toxic absorption, a presumption of valvular incompetence is created which should be subjected to proof."

NAEGELI, TH. Scoliosis Due to Congenital Anomaly of the Spinal Column. (*Beitr. z. kl. Chir.*, Vol. 99, No. 1. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 152.)

The author communicates the pathological history of two patients and describes a specimen of the Zurich Anatomical Institute (Prof. Ruge), illustrated by photograms and roentgenograms. In both cases there is a "numerary variation" of the spinal cord in the shape of inserted or wedged vertebræ.

The first case refers to a 20-year-old girl with a wedge-shaped supernumerary vertebra between the right second and fourth thoracic vertebræ, which was completely fused with the fourth. "The normally developed rib of the corresponding side constitutes the proof of a true vertebral element. Thus, only one half of the third thoracic vertebra has attained to its full development, completely losing its independence and being entirely fused with the neighboring vertebra."

The second case refers to a young man of 19 years, with half a vertebral segment growing between the ninth and eleventh thoracic vertebræ. The semi-vertebra, however, has preserved its independence and is not fused with the neighboring vertebræ. It is connected with a normal rib.

The specimen does not show a defective vertebral segment but a supernumerary wedge-

shaped, left segment between the fourth and fifth lumbar vertebræ.

The supernumerary vertebra has in both cases caused a deflection on the vertebral column which is clinically recognizable by a more or less circumscribed scoliosis. These cases, therefore, establish the clinically important fact "that this kind of anomaly is the cause of certain scolioses which formerly had been relegated to the habitual group."

DRUENER. Locating Projectiles with the Stereoplanigraph. (*Deutsche med. Wchnschr.*, Vol. 48, No. 42, Nov. 30, 1916, p. 1482.)

The author resuscitates an apparatus which has long been known in photography and adapted to roentgenological requirements by Eijkman in 1909 under the name of "symphanator."

The method presupposes a thorough knowledge of planimetery in its practical bearings, including the working out of formulæ. Twelve planimetric figures explain the working of the apparatus in the abstract, and the formulæ pertaining thereto have been worked out.

The advantage of the method is that it can do more than any other method working without stereoscopy and is therefore particularly suitable in the location of bullets where the determination of the topographical position is of greater importance than the determination of the exact measurement. The author admits that to become popular the apparatus must undergo considerable simplification, and his method of employing it is here communicated with the intention of paving the way to such simplification.

WERNER, PAUL. A Case of Congenital Scoliosis. (*Arch. f. Gyn.*, 1915, Vol. 104, No. 2. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 153.)

This is a case of high grade congenital scoliosis with cranial asymmetry, compulsory malposition of the arms, incomplete amputation of the right fore arm, compulsory malposition of the legs, high grade club foot, left scrotal hernia and right patent inguinal ring. The child was born of a hereditarily untainted mother with a uterus bicornis unicollis, with oligohydramnia.

Roentgenological Findings.—Vertebræ and ribs are perfectly normal and well developed. The curvature of the spine has simply resulted from compression of the intervertebral disks. Pelvis and hip joints intact. In the left knee joint there is a backward luxation of the lower leg. Radius and ulna are rudimentary, only the proximal parts being present and well developed, and the terminal ends being pointed without forming the distal joint.

KUEGLE, F. H., AND WOHL, M. G. *X*-ray Immunity. (Read before the Nebraska State Medical Association, Omaha, May, 1916.)

The authors summarize the literature on the immunity of the animal organization following the action of *x*-rays. They also make some rather indefinite references to experiments done by themselves. They state: "From our work which is still in progress, it would seem that exposure to the *x*-ray is accompanied by an initial increase in leucocytes, which decrease upon subsequent exposures. The lymphocytes show a greater tendency to diminish than the polymorphonuclear leucocytes. There is no doubt that diminution of leucocytes is due to destruction, occurring in the blood-making organs. This is of practical importance as it indicates that the spleen should be protected as much as possible during the application of the *x*-ray."

They also refer to experiments on guinea-pigs and rabbits. It would be interesting to learn the details of their experimental work.

SCHOENFELD AND DELENA. Roentgenology of the Lower End of the Sacral Bones and the Coccygeal Vertebræ. (*Fortschr. a. d. Geb. d. Roentgenstr.*, 1916, Vol. 23, No. 6. Ref. *Zentralbl. f. Roentgenstr.*, 1916, Nos. 5 and 6, p. 153.)

In view of the fact that roentgen findings often show form changes and affections of the sacral vertebræ, especially of the lower ones, these authors have examined a matter of one hundred and forty roentgen plates to elucidate the conditions. Schoenfeld confirms the statement of all other anatomists to the effect that all terminal vertebræ have a considerable tendency to variation. The foramen sacrale quintum was found bilateral in only 5 cases. In most cases there was an articular connection between the first and second coccyx, while there were osseous communications between the others and also between the first coccygeal and the last sacral vertebræ. There were

usually four coccygeal vertebræ. Transition forms or assimilations at the border vertebræ of the sacrum were repeatedly observed. Schoenfeld describes three cases, illustrated by roentgenograms, representing fusions of the lateral parts with formation of one or both foramina sacralia quinta. He also describes a pelvic exostosis, being an ossification of the ligamentum sacrospinosum.

Bosio, Pier Giulio. Roentgenological Studies on the Influence of Alcohol on Gastric Motility. (*Radiologia Medica*, Vol. III, Nos. 3–4, Mch.-Ap., 1916, p. 55.)

The author's studies refer merely to the influence of alcohol on the motility of the stomach and not to its action on the gastric juice, the chemistry of the stomach or gastro-intestinal digestion. In the first part of his article he gives a short historical account of the opinions of authors on the above subject as based on clinical experiments, going back as far as 1760 when Josse stated that moderate quantities of good alcohol had no appreciable or possibly a slightly accelerating effect. Since then the opinions of various authors he cites have been divided on the subject. These experiments suffered from the drawback that they were carried out with the aid of the stomach tube and it stands to reason that by this means not many subjects could be examined nor could the examination be repeated many times in the same subject. Another objection was that the introduction of the stomach tube stimulated the function of the stomach and therefore evacuation.

Next are mentioned several investigators who determined the time required for various substances, mixed with bismuth, to leave the stomach, as evidenced by the roentgen findings, but the author is not aware of any previous roentgenological studies showing the effect of alcohol on the passage of food. He selected his subjects partly from convalescent patients, but preferably out-patients of his clinic with healthy stomachs, and students. Three or four who were habitual users of alcohol have been separated in the protocols.

The technic was as follows. Tapioca was stirred into 500 gm of boiling water to make a paste, extract of meat (usually Liebig's) was added, and finally 50 gm of finely powdered barium sulphate. This meal was given in the morning on an empty stomach. Several successive exposures were made in order to hit upon the moment the stomach became empty. A few days later the paste was again administered but with the addition of a certain quantity of alcoholic liquor. In the first experiments Marsala wine was taken, but later ordinary Piedmontese wines were used which contain about ten or twelve per cent. of alcohol. The quantity of alcoholic liquor varied between 100 and 250 c.c. In each case the patients were observed at different periods to control the evacuation of the stomach. The observations were made in the erect position before the fluorescent screen, and in the intervals the patients moved about freely, maintaining the erect position. Special attention was paid to the quantity of the residue at different periods. In a few cases the emptying of the stomach was missed, but guided by the experience obtained from the other cases, this could be determined from the residues at various intervals. Several maneuvers were resorted to during the observation to obtain a more precise idea of the quantity still present in the stomach, such as palpation, etc.

The experiments were made with an apparatus having a rectangular diaphragm with a changeable aperture, and the tube was adapted to the configuration of the stomach. The author gives the protocols of his observations in 22 cases, with the following results:

The average emptying time of the stomach was about two hours and a half, while according to the best authors the time required under normal conditions is from three to four hours. But in all his students there was a tendency to accelerated evacuation and the cases were not rare where in the control experiments with bismuth alone the stomach was found empty after two hours to two hours and a half. This was probably due to the fact that the paste was rather liquid. Meals containing meat, bread, etc., were still found partly in the stomach after five to seven hours.

Reviewing the results in the various cases, the author arrives at the following conclusions:

(1) When the opaque meal was mixed with moderate quantities of alcoholic liquor (Marsala wine), the roentgen findings showed no delay in the period of digestion.

(2) In a few cases the effect has been to accelerate the evacuation of the stomach.

These conclusions, however, have nothing to do with the influence alcohol may have on the general economy when absorbed into the system, or with a possible reaction on the gastric innervation in the course of time.

BOOK REVIEWS

THE MEDICAL CLINICS OF CHICAGO, March, 1917, Vol. II, No. 5. Published Bi-Monthly by W. B. Saunders Company, Philadelphia and London.

Quite naturally a publication which endeavors to persistently promote the attention of the profession to the clinical application of recent knowledge would be expected to present articles upon Anaphylaxis, Fulguration of Bladder Papillomata, Oral Infections vs. Systemic Diseases, Renal Tests, Chronic Constipation and numerous other subjects.

The March issue of the Chicago Medical Clinics presents these subjects among thirteen other topics. The arrangement of this edition is always excellent. The brief abstract preceding each clinic is stimulating. The personality of the authors seems to stick out of the pages in a sort of heroic attitude. Biography and autobiography are interesting, though little seems to creep into these pages of sufficient age to be called biography. We might, however, accuse certain authors of mock-heroics.

After a superficial perusal of chapters upon Anaphylaxis by Tice conveying the conclusion that typhoid patients not treated with vaccine did better than those who received vaccine, and an extensive collaborated article by Williamson and Speed upon Pericarditis Purulenta, and a masterful differential analysis and diagnosis of Chlorosis by Belfield, we find a roentgenologist's attention halted with a bilateral discussion upon oral foci of infection.

Schuhmann presents an ambiguous argument which at first reading seems iconoclastic. Careful analysis, however, is more satisfying. He seeks to differentiate between alveolar pus conditions and blind abscesses (granulomata). He seems to discourage dependence upon dental roentgenograms and passes their interpretation on to the next fellow. He rather doubts the importance of granulomata, as the results from their removal are discouraging. He then contradicts himself by magnanimously refusing to belittle these blind abscesses as they are so frequently found in association with arthritis, endocarditis, cholecystitis. Schuhmann admits many things but refuses to be convinced. Fortunately his last paragraph comes to the rescue of the reader when we note that "the presence of oral foci of infection produce as a result of their presence a low-grade secondary infection generally, and lower the host's opsonic index to various infectious organisms, but do not *per se* cause the occurrence of distinct bodily diseases. Their prompt removal is followed immediately by a rapid return of vital resistive power to the individual, which resistive power may be accelerated by the addition of autogenous vaccine treatment in such cases where physicians deem it advisable to bring about a more rapid change to the normal."

Then follows a report of a rare case of Bacillus Aerogenes Capsulatus Infection of the Intestines by Dr. Charles Louis Mix and a clinic upon Aneurysm of the Aorta by the same author, with stereoscopic roentgen verification of the latter. In fact, the *x*-ray findings in aortic cases receives an unusual boost when Mix states that "Any or all of these (physical) signs (of aneurysm) may be absent and only the *x*-ray may be potent in establishing the diagnosis."

Two other articles attract comment. Smithies carefully and thoroughly presents a case of retroperitoneal sarcoma but the roentgenologist would reserve criticism upon the fact that a roentgen technician is exploited (probably because there are too few roentgen consultants to go around), and again the paragraph upon ***actinotherapy*** is misleading. May we suggest ***roentgenotherapy*** as a more correct nomenclature and ask for a description of technic more in keeping with present knowledge? It is not altogether encouraging to find half a paragraph admitting the possibilities of roentgen treatment devoted to a discussion of roentgen burns. It would seem that burns were quite the custom with technicians. It is otherwise with roentgenologists.

This entertaining edition ends with a good article by Friedman upon the best producing symptom in medicine—constipation. What good old doctor fails to ask about this symptom and how wise he looks in his ignorance of the analysis of this symptom. "Are you constipated?" "Yes." "What do you use?" "Oils." "Then use these pills." "Thank you, doctor, when shall I return?" "When your pills wear out, then take oils." And so we have vacillated between bullets and floods until now the clinician backs up the roentgenologist and insists upon a roentgen examination to determine the type of constipation. Atonic (?)—Spastic—Dyschezia—Pathological—Congenital—it would almost seem that this symptom of the ages was to be split up into basic elements and perhaps even the electrons and ions may be evolved by the alchemy of roentgenology.

E. H. S.